The Mysore Economic Journal

APRIL 1920.

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The Mysore Economic Journal

A Monthly Periodical devoted to the Discussion
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PUBLISHED UNDER THE AUSPICES OF THE MYSORE ECONOMIC CONFERENCE

VOL. VI | APRIL 1920 | No. 4

LEAVES FROM A DIARY.

Education in Japan—II.

BY "M"

FOR carrying on a satisfactory system of national education, the first step was to provide good teachers, Government engaged American and English instructors at first and at the same time began training abroad their own men for the work. Picked men from its schools and colleges were sent to receive education in Europe and America. In 1873, there were 373 Japanese students in foreign countries, of whom 250 had been maintained at Government expense. This number was subsequently reduced. By the end of 1890, about 67 students had returned home many with diplomas and other honors, some these were appointed professors in the University and other institutions which others were taken into public service in the departments to which their special training had fitted them.

There were 59 students maintained on Government stipends at the time of my visit in 1898. The greater number 26 of these were in Germany where the Japauese believe the quality of education imparted is more perfect than in any other country. It is cheap also. The subjects they were sent to study were agriculture, metallurgy, commercial science, Political Economy, Civil Engineering, medicine, law, history and philosophy. Two students were in England one studying naval architecture and the other a female student in the training school at Cambridge. One was in France studying fine arts, two in Austria studying medicine and one in America studying Chemistry. The remaining 27 students were deputed to visit more than one country studying in each all that could be learnt in his special subjects. They were to learn one are more of the following subjects. Fron manufacture, electric engineeriug, seismology, chemistry, fine arts, botany, commercial science, law, politics and the method of instructing the deaf and the blind. The stipends allowed were £150 yearly for Germany and £ 180 for other countries. Though America was nearest to Japan, the education imparted there was considered expensive and superficial, the German, bring thought hoth good and cheap.

PRACTICAL CHARACTER OF EDUCATION.

The object of the Japanese Government is to make the nation strong and prosperons. The goal kept in view by each class of education is clearly defined and the system of instruction necessary to attain that goal is worked out with a desirable thoroughness. To become strong and wealthy, they or their leaders are combined that nothing but European ways of their king and Eurapean methods of work will avail them. They recognise that to become a powerful aud united nation, they must foster loyalty, patriotism, discipline and sense of duty. This is done

by military drill in the schools and by instruction given in morals and ethics in every elementary or high school. They aspire to become prosperous and rich and they have found out from the examples of England and Germany that industries and trade should be developed. English as the representative language of the highest civilisation and science is made a second language in the public schools and the University. Not only are a large number of commercial and technical schools scattered through out the country, but in elementary schools also, they have supplementary classes to teach the student the use of the eye and the hand. It will be seen further on even the highest scientific education is given at the Universities which are made not merely receptive but productive centres of education.

Discipline, industry, training for practical life, the highest training in the practical science and arts and political economy. These sum up the character of the present day education in Japan and all this has been developed with startling suddenness.

The result is there is perfect discipline in the workman who does the work entrusted to his whether the master's eye is on him or not and who will not be enjoled or bribed out of it. This excess of practical elementary education, not the sort of elementary education given in India, where a youth is taught just enough to discard the occupation of his fore fathers and not sufficient to turn his hand to any new occupation. General education is all very well when combined such combination, it may elevate the mind without bringing food to the stomach. The teaching of economics receives special attention in Japan. Political economy as it concerns individuals is taught in the elementary schools under the subject of morals. Political economy as regards the higher occupations, commerce and the State is taught in the special colleges and Universities. The absence of instruction in the science of economics is a serious defect in the Indian system of education. The sense of proportion and the faculty of finding not for the present only but for the furture is wanting in the ordinary public men and journalists in this country and is at the bottom of many errors into which they so frequently fall.

Professors.

I have already said that the work of the professors is largely a matter of self-sacrifice. In the Government publications giving a history of the University no Japanese names are mentioned among the promoters. In European countries, they would take a pride in perpetuating such names. In Japan, the workers efface themselves out of humility. They all sink themselves in their work.

The Japanese student.

The Japanese student takes his studies very seriously. An eminent Scotch professor one of the oldest professor in the Tokio Imperial University spoke of his pupils in terms of affection. "The students" he said *note* upon speaking an untruth as base and are very good. The Japanese graduate is better educated than the English graduate. The Japanese is most serious. He is a beautiful super-minister. The English students are fond of *fun* and are less answerable to discipline. The Japanese graduates are at the top of their classes in Germany, England and America. But the Englishman develops as he grows but the Japanese does not improve in the same degree in after life.

If a Professor does not teach well he is turned out by the authorities. The students are usually the instrument. They are not mischievous but are very shrewd and wise. The authorities listen to the voice of the students (thougb not openly) and remove a Professer who does not give satisfaction. Students are in this respect a power in the University.

"As for the typical Japanese student, "says," Professor Chamberlain, he belongs to that class of youths who are the schoolmaster's

delight-quiet, intelligent, deferential, studious almost to success. His only marked faith is a tendency common to all subordinates in Japan to steer the ship himself. 'Please sir, we don't want to read American history any more. We want to read how balloons are made.' Such is a specimen of the requests which every teacher in Japan must have had to listen to over and over again."

GENERAL SYSTEM.

The highest education is that which culminates in the University and a student aspiring for University honours has to pass through the following course of instruction.—

Lower and upper primary	6 years
Middle school	3 or 5 years
High School	3 years
University	3 or 4 years

Thus a boy who begins his education in his sixth year, completes his Unirersity course at the age of 23 or 24 if he prosecutes his studies without interruption. For those who have no desire or cannot afford to study for higher courses, supplementary instruction is provided to enable them to hurry over subjects which in the regular course as usually taught at a later stage.

The system of education was originally on the lines followed in America but at present it is largely on the German model. As already remarked, education is compulsory by law and it is binding on the parents to keep at school every boy or girl between 6 and 14 years of age until they have completed the ordinary elementary school course. The law is indulgently administered. Many exceptions are made for poverty and sickness as the country is not in a sufficiently prosperous condition to afford absolute compliance. At the age of 20, every able-bodied person is required to undergo military training for 3 years. In the case of students, this period is extended up to the 28th year so as not to interfere with their education. After the 28th year, no student could be at a college or a University. The period of military service is reduced to one year in the case of those possess who are able to serve in the army at their own expense.

ELEMENTARY EDUCATION.

The elementary schools are intended according to Government reparts for giving children the rudiments of moral education and of education specially adopted to make of them good members of the community together with such general knowledge and skill as are necessary for practical life, due attention being paid to them readily development. Knowledge and skill imparted to children should be sound and practical. Such topics, it is laid down, as refer to the necessities of daily life and conduct should be selected and taught so as to enable children intelligently and practically to apply what they have learnt.

When the parents are unable to pay tuition fees, provision is made with regard to the whole or partial remittance of those fees and the substitution of payment in kind or in personal labour in order to facilitate the attendance of children.

Handwriting used to be assidiously cultivated as an art hitherto but the number of schools which teach this is now discouraged and has been reduced; because as the official account says "the recent progress in arts and science as also the daily occupation of the people has made the latter feel the necessity of studying more useful subjects and not continuing themselves with a mere knowledge of writing."

The elementary schools are of two classes *viz.* the ordinary and the higher. Both however may be combined into one institution in any locality. The subjects of study in the ordinary elementary schools are, morals, reading, composition, writing, arithmetic and gymnastics. According to local circumstances, gymnastics may be omitted and one or more of such subjects as Japanese geography, Japanese history, drawing, singing and handiwork may be added. The subjects taught in the Higher elementary schools are:

Morals, reading, composition, writing, arithmetic, Japanese geography, Japanese history, foreign geography, science, drawing, singing and gymnastics. One are more special courses in agriculture, commerce or industry may be established according to local wants. There are also supplementary courses in which instruction is given in agriculture, industry, or commerce or such subjects of study as have immediate reference to the present or future occupations of the children.

All expenses for elementary schools are to be borne by the cities, towns or villages concerned. In exceptional cases aid is given from the local revenues. The education is entrusted to a school committee under the official head or superintendent of each city, town or village. The teachers in the schools should form not less than ¼th of the whole number on the committee. Government insist that each city, town or village shall establish and maintain schools sufficient to accommodate children of school are resident therein. Government insist also on a certain general standard being maintained for the rest, great latitude is left to the local authorities as to managements and the special subjects to be taught according to the occupation and wants of the people in the locality.

In teaching *morals* in every school, the special object is it is laid down, the cultivation of the conscience of children, the fostering of their moral sensibilities and the enforcement of the practical performance of human duties. It is provided that the spirit of loyalty and patriotism shall be specially awakened. The young student is given advice regarding the social sanctions, sense of honour and his duties towards the state. Teachers are enjoined to take pains to secure firm and lasting results.

In teaching *geography*, it is provided that instruction shall commence with a description of the physical features of the district in which the children live. According to the length of the study, minute description shall relating to the life of the people with reference to political economy.

In giving instruction in natural science, the young student should be made to comprehend such topics as the relation of plants and animals among themselves and to man, the physical and chemical phenomena of common occurrence and the constitution and operation of such apparatus as come under daily observation, the elements of human physiology and hygiene being taught at the same time. Those topics which relate to agriculture and industry should as far as possible be given, besides such as are specially adopted to the requirements of daily life.

With regard to instruction in gymnastics, in higher elementary schools, boys are chiefly instructed in military gymnastics and girls in common gymnastics or *calistheruics*. Outdoor exercise and excursions in the country are encouraged. Instruction in swimming may be given in summer.

Where manual work is taught, the articles manufactured should be such as are useful for practical purposes, attention being always paid to the formation of economic habits. In cases where agriculture is taught, practical lessons are provided when possible to cultivate the taste for agriculture and to foster the habits of frugality, diligence and saving.

In cases where commerce is added to the courses of the higher elementary schools, the topics taken are those which have an important bearing upon such subjects as shops, companies, buying and selling, circulation of currency, transportation, insurance etc. and of those which can be easily comprehended shall be taught in accordance with the commercial usages and regulations. A simple system of commercial book-keeping is also taught.

Female children while young are taught in the same schools as boys. If the number of the former be larger, they are taught in separate classes where cutting and sewing is taught, specially to female children, the object it is stated is to make the children proficient in the *cutting and sewing of garments for ordinary* wear. Instruction is given in the

mending of common garments, the preservation and washing of dresses, attention being always paid to the desirability of frugality.

Of the elementary schools I visited, I have very pleasant reminiscences of my visit to the primary school attached to the higher normal school at Tokio. A Professor of the higher commercial school, a gentlemen of a most sweet and obliging disposition, accompanied us. In one of the classes we noticed the students marching in martial order into the school room singing some national songs. We next visited a class where mental arithmetic was being taught. Each boy was provided with a separate stool and desk. The teacher put a question and several boys raised their hands to show that they knew the answer. The teacher chose one of these to give the answer and he did so. When the answer was incorrect or absurd, there was general laughter. All the boys were in the school unifrom which has a military style. Their overcoats, caps, umbrellas, and other belongings were left in the verandah all arranged according to some order without the possiblity of a mistake, which was a model of neatness. We were next taken to a class where singing was being taught to the accopaniment of a musical instrument. They sang to us the national anthem of the country. Then we went to a class of children of about 6 years of age, all dressed similarly, a most pleasing sight. In every class we visited, we noticed nothing but cheerful faces.

There were 485 children in all in the school. The school fees ranged between 12 annas and Rs. 2-4-0 reckoned in Indian money.

The Japanese children spend much of their time at school. Our friend the Professor informed me that in his school days, they went very unwillingly to school. There is no competition in the classes for daily rank.

There are music classes and military drill for amusement and exercise and to relieve the monotony of writing and arithmetic. The teachers do not frown and children are willing to go to school. The Professor told us that corporal punishment in the school room was unknown in recent years in Japan. For this, however, I cannot vouch, as a University student to whom I mentioned the Professor's remarks put on a long face and replied, "All I can say is the Professor has forgotten his school days but my own experience is of recent date."

INDUSTRIAL DEVELOPMENT OF SOUTH INDIA.—III *

General and Educational.

By Gilbert Slater, M.A., D. Sc.,
Professor of Indian Economics, University of Madras.

SINCE I began this short course of lectures, I have received communications from various gentlemen calling my attention to specific problems. On some of these I propose to touch this evening, using them as illustrations of general principles.

I. I have reveived a circular which proposes at once the establishment of Vernacular Schools of Navigation, and the launching of a 'Madras Ship-building Company, Limited', the greater part ot the capital of which is to be devoted to the building of a steamship. Now industrial development must include development in the three fields of agriculture, manufacture and transport. Land transport is in India peculiarly a matter for Government, which in one form or other is almost entirely responsible for both roads and railways. But the sea lies open to private enterprise. I am therefore not surprised that Indian industrial ambitions are continually pointing towards the creation of a great Indian ship-building industry and the establishment of Indian steamship lines. But, on the whole, I fear I must warn you against hastily putting money into companies for this purpose at present. Established lines have an awkward habit of resenting the coming of a new competitor, and, if that new-comer is not very strong, of endeavouring to crush it out of existence. The general idea I would like to suggest to you here is the desirability of building on an exis-

*A Lecture delivered in Madras. The first and second lectures of this series were published in the January and February issues of this Journal [Ed. M.E.J.]

ting foundation. The building of sailing-ships *is an industry which has never ceased* in India, and such ships make reasonably profitable trips from one Indian port to another, and even go further afield. Would not the next step in development be the building of somewhat bigger ships, eqipped with auxiliary motors, either petrol or Diesel oil engines, which could make way against a calm or moderate head wind, while still exploting the advantages which the comparative reliability of Indian winds afford to sailing-ships pure and simple? Such a development would not excite the jealousy of the British India Steam Navigation Company and if it were sufficiently successful migh serve for a fresh starting point later on.

II. Since last week another new enterprise was brought tc my notice. Mr. S. Ramachandra Aiyar called upon me, and arranged for me to see the ' Ramachandra water-lift' in operation. You doubt, less or familiar with the ordinary bullock water lift of the Madras Presidency, said to have been invented many centuries ago by a famous Indian mathematician called Kabala, and hence termed the Kabalai. The Ramachandra water-lift is a simple and ingenious modification of the same idea. One ox takes the place of the pair. The slope away from the well is made slightly *steeper and iron rails are laid down on it*. On these a low platform slides, supported on four cast-iron wheels. The oxfaces the well instead of having his tail turned towards it. He stadds with the driver on the platform, which then rolls gently down the inclined plane, drawing up the bucket full of water. At the end of the run the bucket automatically empties itself the ox and the driver step off the platform, and the weight of the bucket descending to the water draws the light platform up the slope. The ox and the driver walk after it and the whole process is repeated. I must say that I was greatly impressed by what I saw. The ox does the work by walking in a perfectly natural manner up a slope, and therefore uses his strength in the most effective and least tiring manner. *I have great hopes that tests under expert* supervision will justify Mr. Ramachandra's confidence in his invention. But the general principle I desire here to emphasize is that great gain will result when the ablest intellects in India are in some measure diverted from abstract and legal and political studies, and directed towards the solution of the ordinary problems of lite.

III. A good many people have complained to me that in my two previous lectures I said nothing about the tariff question, and that they consider, is the very root of the matter of Indian industrial development. Now *rather more than three years ago, when I had* newly arrived in Madras, I spoke upon this subject. I then expressed the opinion that as Indians appeared to be so unanimous in desiring a protective duty on cotton goods, this ought to be conceded, both because the refusal makes it appear as though Lancashire interests weighed more with the Secretary of State than Indian wishes, and also because as long as Indians believed that the tariff was the one thing necessary they were not likely to face the real problem until they were allowed to try their remedy. Since then the Government of India has moved, in my opinion quite rightly, in that direction, and we have now had, for some time, a protective import-tax of 7½ per cent ad volorem on all imported cotton goods. The real effect of this *will* be seen later. Hitherto a 7½ per cent tax has been a small matter compared with the difficulties of manufacture and transport created by the war, and still persisting since its close. I am bound however to confess that the response of the Indian manufacturer to the opportunities created *for him* by the difficulty of securing foreign goods, and to the need for increased production of Indian goods, has been somewhat disappointiug.

Nevertheless a tax upon imported cotton cloth appears to me to have merits of another

character. Since the Indian handloom weaver and the Indian mills supply the cheapest and coarsest cloths used in India, a tax on imported cloth is a tax on those who are best able to pay. It is tolerably well graduated according to income; whereas an income-tax proper is very unsatisfactory in India in consequence of the extreme difficulty in ascertaining what people's incomes are. An increase in the revenue seems to me imperative. Prices have risen greatly and are not likely to fall for many years to anything like the pre-war level, therefore all the expenses of Government are greatly increased. They are not increased as yet nearly as much as they ought to be. All small salaries paid to Government servants have become, through the rise of prices, miserably inadequate, and ought to be greatly advanced; and there are also many directions in which a great increase of Governmental activity is required. People say the need should be met by eliminating waste. But there never was, and in our time there never will be, any Government that did not waste money. A certain percentage of waste is a constant feature of all Governmental machinery, just as a certain amount of friction characterises all mechanical machinery. Compared with with other Governments that of India appears remarkably good, and I, for one, do not expect to see the slightest improvement in this respect coming as the result of the adoption of the representative principle. Representative Government has its merits, but nobody can say that has ever been found economical.

The question will have to be determined whether the small beginnings of a protective tariff already established in India shall be further developed. The modest 7½ per cent may be greatly increased. What will be the effect of that? In my opinion, simply that foreign capitalists will come into India and set up their factories here. The share of Indian firms in the industrial activities carried on in India would, I think, be reduced instead of increased. How are you going to deal with that difficulty? Obviously it can only be met by developing the capacities of the Indian people themselves.

So, therefore, stating the matter as seen from the broadest point of view, the problem of Indian industrial development is two. fold; it is the problem of conserving and developing the natural resources of the country; and then of conserving and developing its human resources. Let us take the former first.

Are we conserving the natural resources of the country? Are we not rather allowing some of the most important of them to be destroyed rocklessly?

India was at one time, there can be little doubt, almost entirely covered by forest. By slow degrees, the greater part of the country has been cleared and brought under cultivation. That is good, up to a certain point. It is calculated that in a temperate climate like that of France or Germany three quarters of the area may properly be cleared, but one quarter should be kept forested. In a tropical country like India the need of forest is probably greater, especially on hill and mountain slopes where the soil is washed away by the heavy rains wherever unprotected by tree roots. But India, leaving out Burma, has only 12 per cent of its area under forest. Further, much that is called forest and which was forest once is now treeless waste, producing nothing but rocks, prickly-pear, euphorbia, land ruined and devastated beyond hope of recovery. In the neighbourhood of Salem, I have hunted for tree life over the unreserved forests. Here and there is a sacred grove still surviving under the protection of a deity. But for the rest I discovered one tree, growing in the cleft of a rock, in a position equally inaccessible to goats and human beings. Even the condition of the reserved forests in the neighbourhood is but little better.

I think that one of the most discouraging features of Indian life is the manner in which

this question is handled by the speakers and writers who have taken on themselves the responsibility of guiding and expressing Indian opinion. Never does one find a speech delivered in the Legislative Council, or an article in the Indian Press urging upon Government more effective conservation of the forests. It is the officials of the Forest Department alone who are struggling to conserve this most valuable heritage of the Indian people, and they have everyman's hand against them. The peasant of neighbouring villages claims a fancied right to pasture his cattle on forests which by right belong just as much to villages at a greater distance. Forest is land bearing a growing crop of trees, just as much entitled to, and just as much requiring protection, as a growing crop of rice, or wheat or cholam. For one village to turn cattle—and still worse goats—into a forest which ought to serve many villages as a source of timber and fuel, s like one ryot in a village turning cattle to graze over the growing corn crops of the whole village. For a very small immediate profit to a few people the permanent interests of a whole community are sacrificed.

India must learn to be less tender of individual interests, more resolved to vindicate the general rights of the community. Her economic salvation depends upon it.

Now let us consider the question of the conservation and development of the human resources of South India.

Here let me give you the fundamental proposition of Economic Science which you will not find clearly expressed in any economic-text book hitherto published. It corresponds to one of the fundamental laws of Physics. Newton's third law of motion, 'action and reaction are equal and opposite.' We cannot make so precise a statement in economics. The law must read 'action is always accompanied by reaction, and, taking the whole field of human activity, action and reaction are equally important'. In any particular case the action may be vastly more important than the reaction, or the reaction than the action. If a blacksmith strikes the hot iron on his anvil, the action, what he does to the iron, is more important than the reaction of the blow on the mind and body of the smith. But if a University student strikes a tennis ball on the Court, it is the reaction that is more important. But both are present in both cases. If it is reaction which we have in view, the activity is of the nature either of education or recreation; if the action itself, the activity is industrial. But since the two are inevitably linked, it follows that every industrial activity has its educational reactian. When the department of Industries set up a pencil factory here in Madras it acquired two things; in the first place a certain quantity of pencils of various kinds and qualities, and in the second place the knowledge of the process of making pencils in Madras, and the power of doing so at a profit. And as this is capable of being used as a means of acquiring the power of making other things also efficiently and profitably, it is of infinitely greater importance than the pencils themselves. Similarly, if the well-to-do gentlemen of Madras were to successfully launch and carry on efficiently a Ship-building Company, Madras would acquire not ships only, but an increase of industrial capacity.

It is by effort and by action that humanity learns. I think we want to get that idea into the Indian educational system. Yesterday I happened to look into a book about my native country of Devonshire by the well-known novelist Mr. Baring Gould. He described how he went into a school nestling below the hills of Dartmoor with His Majesty's Inspector. First the Inspector asked the children questions. He asked them to name the rivers of Siberia, and they did. He asked them to name the highest mountains of Africa, and they did. He asked them to give the height of the highest mountain of Africa and they did. And the Inspector was pleased. Then Mr. Baring Gould asked

questions. He asked them to give the name of the river which flowed through their village, and they could not. He asked them to give the name of the hill that overhung the valley, and they could not. He asked them how high the hill was, and they did not know. He asked the name of a common wild flower he had picked in the lane, and no one knew it. 'This', he cried, 'is the rubbish which we inflict on the children and call education.' Is there nothing of that unreal, unimaginative bookish quality in Indian education?

I have seen complaints that where the village school just teaches reading and writing in the vernacular, the ryots are very indifferent as to whether the children attend or not. I think that is perfectly natural. The children probably learn a great deal more out of school helping their mothers when they are little, and their fathers when they are bigger, than they do in school. Boys and girls who learn to read English have access to all the science and most of the literature of the world opened to them. The boy or girl in a South Indian village who learns to read Tamil, what has it open to them? Judging by the books I have found accessible in villages scarcely anything of value. Even the ancient poetic and dramatic literature of the country itself, so far as I can ascertain, is made quite as familar, by travelling reciters and dramatic performances, in the backward districts where few know how to read and write as in those better equipped with schools. In many a district of England the old songs, games, and dances which did so much to sweeten toil have vanished before the blighting contact of the public elementary school. I fear a similar phenomenon in India. The teacher who is of use is the man who has made and is making a success of his own education and his own life, the man who is efficient in other things than in the subjects he teaches in the school, the man who makes his power and influence felt by the adults in the village as well as by the children. Such a man can help children to grow up into efficient men and women and good citizens. One or two school masters of that type are more good than hundreds who take to teaching and accept starvation pay for that exhausting work, because they are fit for nothing else.

For the details of educational reform, I have no time now. I must content myself with the remark that a much closer linking up of the school curriculum with the actual industrial life of the village or town in which the school is situated will be good both for education and for industry.

In conclusion, as I am now completing this my third lecture on 'Industrial development', let me remind you that industry exists for man, not man for industry. India might hum from end to end with the machinery of cotton mills and woollen mills and silk mills. Her stores of coal and iron might be exploited to the utmost, her ports might be crowded with ships of her own building, carrying her manufactures all over the world, and yet the average Indian might be no better and no happier than he is to-day. Industrial development gives economic power. Economic power is neither good nor evil in itself, all depends on the use which is made of it. The Western world has been too absorbed in its pursuit of industrial efficiency and material powers, too little careful about the application of such power to the best and highest uses, and it has received a terrible lesson. India needs to put more effort, more intelligence, and more conscientiousness into industry. But India must also realize the importance of securing the just distribution of the fruits of industry, and of wise use of economic power to promote health, happiness, intellectual culture and spiritual advance.

SUGAR-CANE CULTIVATION IN MYSORE.

BY LESLIE C. COLEMAN, M.A., PH.D.

THE average area under sugar-cane in Mysore for the decennium 1908-09 to 1917-18 was 38,368 acres. The variation was from 32,287 acres in 1915—16 to 44,404 acres in 1911-12 (See Table I). The average area under irrigated crops during the same period was 960,956 acres so that sugar-cane occupied 4 per cent of the area irrigated. An examination of figures for the previous decennium shows that there has been no appreciable change in the area under sugar-cane for the past twenty years. Annual fluctuations in the area may be quite large but the average over a series of ten years remains about the same.

The great bulk of sugar-cane in the State is raised under tanks, channels from rivers supplying only an insignificant part of the whole and wells supplying a still smaller area. It is, I think, safe to say that not more than 7·0 per cent of the sugar-cane grown in the State is supplied from river channels. The reason for this lies chiefly in the fact that channel supplies are almost invariably cut off in the hot weather so that if the lands are not commanded by subsidiary tanks which may in some cases be filled from the channels during the monsoon season it is impossible to grow cane. The restriction of the growth of cane to areas under tanks helps to explain why our area is not increasing. Of the 20,000 odd tanks in the State, only a comparatively small number have an assured perennial supply.

The fluctuations in area noted are due to a combination of causes. Undoubtedly the

TABLE I.

Area in acres under Sugar-cane according to Districts.

Year		Bangalore	Kolar	Tumkur	Mysore	Hassan	Shimoga	Kadur	Chitaldrug	Total for State	Total Irrigated area
1908—09	...	3,897	7,879	1,830	4,027	5,717	7,850	1,878	878	33,256	8,88,862
1909—10	...	3,157	6,377	1,576	7,007	9,923	5,052	1,017	863	34,972	9,39,250
1910—11	...	4,433	8,349	2,120	4,975	10,728	6,388	1,189	2,328	40,510	9,74,694
1911—12	...	5,558	9,874	3,226	6,010	6,471	8,128	1,403	3,734	44,404	9,48,463
1912—13	...	5,519	8,962	3,976	6,767	6,632	6,679	1,662	1,358	41,555	9,71,343
1913—14	...	5,423	9,078	2,769	6,128	7,275	6,553	1,669	2,123	41,018	9,74,170
1914—15	...	4,384	7,605	1,740	4,621	6,101	7,484	1,778	504	34,217	9,38,074
1915—16	...	4,014	7,320	1,964	4,414	3,879	7,842	1,830	1,024	32,287	9,50,748
1916—17	...	5,124	8,977	1,923	4,915	4,087	8,231	1,738	1,111	36,141	10,14,867
1917—18	...	6,206	9,818	2,447	6,191	6,023	9,061	2,000	2,582	44,328	10,09,089
Average	...	4,751·4	8,423·9	2,357·1	5,509·0	5,783·6	7,326·8	1,616·4	1,650·5	38,268·8	9,60,956·0

Fig. 1.—Indian Sugar Committee Inspecting Jaggory Boiling on the Babboor Farm.

price of jaggery in any one year has a very important influence on the area planted in the following year but the supply of water in the tanks which is determined by the north-east monsoon has also an effect. Unless that supply promises to be sufficient to carry the crop for a whole year, cane will not be planted. Competition of food crops and insufficient labour supply are other important factors restricting the area under cane.

The average size of holding in Mysore is approximately 7 acres. Consequently the area of sugar-cane cultivated by any one agriculturist is usually very small. Only a very small number of land holders grow a sufficiently large area to allow them to install with profit a power-driven sugar-cane crushing plant. On the other hand there are a fairly large number of villages in which the area under sugar-cane exceeds 50 acres, so that there is considerable scope for the introduction of small power plants worked by joint-stock companies or co-operative societies. Efforts in this direction in the past few years have, however, not met with much success.

SUGAR-CANE VARIETIES.

The chief varieties of cane grown in the State are the following:—

1. Pattapatti.—A striped variety supposed to have been introduced about 150 years ago from the Madras Presidency. From two-thirds to three-fourths of the cane area in the State is occupied by this variety. It is a rich cane averaging about 20 per cent total solids, 19 per cent sucrose and 0·5 per cent glucose. It normally matures in 12 months and keeps uniform in composition for about ten weeks after that. In the western part of the State it is grown as a fourteen to eighteen month crop. It tillers well, responds well to manure, and under good cultivation and high manuring, yields from 350 to 400 maunds (28 lbs. equals 1 maund) of jaggery per acre. It does not arrow freely, is not attracted by smut but is readily attacked by borers, pigs and jackals. As it is a top heavy cane it tends to lodge.
2. Rastali.—A soft white cane maturing in about twelve months. It is not so free a tillerer or so high a yielder as pattapatti. Its juice is also not so rich or pure. It is extensively grown in the Chitaldrug District and to a lesser extent in Kolar. It is frequently found as a mixture along with "Pattapatti." It lodges and is attacked by borer, jackals and pigs. A thinner variety of much the same general character is known as "Chitta Rastali."
3. Cheni.—A hard thin white cane, drought resistant. It can be grown on alkaline soils. It tillers freely and is a high yielder under good cultivation. It is grown largely in areas with precarious water-supply, where it is poorly cultivated and receives very little manure. Under these conditions where it is grown as an 18 months' crop, 80 maunds of jaggery per acre would be considered as a fair crop. It is attacked by leaf fungi and smut, but is resistant to jackal and pig attacks.

In addition to these three main varieties, there are a number of others which are not sufficiently important to warrant discussion.

The Agricultural Department has been engaged during the past 15 years in importing and testing canes from outside the State. Most of these have been obtained through the Madras Department. Of these, two

have actually found their way into cultivation and are likely to spread very rapidly. These are the following :—

1. Mysore Java:—This cane was apparently originally obtained from the Samalkota Farm as an importation from Java. As far as we are aware it is not now being grown in Madras Presidency. It is a light coloured cane with a rich juice and produces a fine light colored jaggery. It is not a free tillerer or a very heavy yielder but is becoming popular in the semi-malnad areas where *it is replacing the local pattapatti.* The Java cane matures in 12 months. It flowers and lodges rather freely. The rind is hard, so it is resistant to jackal and pig. It is fairly drought resistant.
2. Red Mauritius.—This cane introduced from the Samalkota Farm in 1906 is the most vigorous and the highest yielding cane we have yet found. It has done well almost all over the State. In addition to its high yielding qualities, it does not lodge and its hard rind protects it from wild animals. It is harder to mill than the local soft canes and does not produce as good a quality of jaggery; moreover, it is susceptible to borer attacks. These qualities make it unpopular in certain areas but its cultivation is spreading as the increased yield more than compensates for the extra labour in milling and the poor quality of jaggery.

Of the other exotic varieties tested here, Java 33 A. seems to be the only one which, up to the present, is promising. In addition to these we have a number of seedling canes many of which are the progeny of the vigorous Red Mauritius variety. None of these has yet been grown on a field scale but some of them have given very promising results on small plots. A number of the more promising seedlings are being tested this year in various different sugar-cane areas to ascertain their growth under different conditions of soil and climate.

The accompanying Table II gives the comparative yields of the indigenous varieties and the chief exotic varieties.

TABLE II.

Sugar-cane variety tests (Hebbal Farm)—Cane in tons and Jaggery in maunds (28 lbs. each) per acre.

Year	Red Mauritius		Java (Mysore)		Cheni		Rastali		Pattapatti	
	Cane	Jaggory	Cane	Jaggory	Cane	Jaggory	Cane	Jaggory	Cane	Jaggory
1913—14 ...	34·5	271	22·9	166	30·8	220	21·8	187	27·9	280
1914—15 ...	49·7	391	32·9	239	44·4	318	31·3	269	40·1	402
1915—16 ...	37·2	314	24·9	210	27·5	198	27·4	257	...	...
1916—17 ...	23·7	209	16·6	140	23·2	190	15·1	147	17·4	190
1917—18 ...	39·33	331	29·89	240	43·18	288	24·1	187	30·53	247
1918—19 ...	44·46	392	27·30	214	43·85	322	...	...	27·01	240
Average 1913 to 1919.	*38·0*	*318*	*25·78*	*201*	*35·5*	*256*	*23·94*	*209*	*28·6*	*272*
Maunds of Jaggory for 1 ton of cane...	...	8·3	...	7·8	...	7·2	...	8·7	...	9·5

'IG. 2.—VARIETIES OF CANE BEING TESTED ON THE HEBBAL FARM. 1. CHENI. 2. LOCAL STRIPED. 3. RASTALI 4. J. 33 A. 5. JAVA MYSORE. 6. RED MAURITIUS.

CULTIVATION.

The most usual planting season in Mysore is the period extending from January to March, the month of February being the favourite planting month. Another fairly common planting season is September and October. Canes planted in this season are commonly allowed to stay on the ground from 14 to 18 months whereas the cane planted in January—March is commonly harvested at the end of 12 months. Although these are the two main planting seasons, there are areas where both planting and harvesting take place in practically every month in the year.

As indicated, the length of growth of the cane has considerable influence on the planting season. Thus in the malnad and semi-malnad areas where it is the common practice to allow the cane to grow 18 months, the cane is frequently planted just before the south-west monsoon so as to allow for milling in the dry season of the year. In other areas again, 18 month cane is planted in June and July.

TYPES OF SOIL, CULTIVATION AND PLANTING METHODS.

While sugar-cane can be and is grown upon almost any type of soil which has an adequate water-supply, still it is customary to use the best soil available. It is in the great majority of cases land upon which paddy is also grown and is therefore a dark clayey or silty loam.

The preliminary cultivation consists in either ploughing or digging the land. Digging is, however, less and less resorted to owing to the scarcity of labour. The wooden plough is still the common ploughing implement but people are more and more realising the advantages of the iron plough for sugar-cane cultivation. With the wooden plough from six to ten ploughings are commonly given. The other main preliminary cultivation is clod-crushing which is still done by hand with mallets. Levelling is commonly done by the log harrow or large bullock hoe

The cane is planted either in pits or in furrows. In the more important sugar-cane areas in the eastern part of the State the furrow system is usually practised, the furrows being commonly not more than one and a half feet apart and the sets being laid end to end in the furrows. In the western part of the State and, in fact, wherever the supply of water is scanty during the early period of growth, the pit system is followed. The pits are commonly arranged in squares three feet apart each way and two sets to the pit. In the case of the furrow system, furrow irrigation takes place from the first; in the case of the pit system, early waterings are done by hand.

For planting, tops are used wherever possible as it is practically the universal opinion that these give more uniform and rapid germination. Whole canes have, however, frequently to be used and in our experience give quite satisfactory results.

After-cultivation consists in weeding, digging, earthing up and wrapping. Wrapping is practised only on thick canes and even with them chiefly in the areas of more intensive cultivation in the Eastern part of the State. Here it forms an important and fairly expensive operation. Ridging and earthing up are common only in the western part of the State where the heavy rains of the monsoon necessitate efficient drainage facilities.

Ratooning is a general practice only in the Western malnad part of the State, *i.e.*, the region of heavy rainfall. In other parts, the general experience is that ratooning does not pay and it is in fact rarely practised. The area of cane on which ratooning is practised is insignificant.

ROTATIONS.

The main rotation is a sugar-cane paddy one. Sugar-cane is usually grown in comparatively small patches surrounded by extensive paddy fields. The result is that drainage is commonly very defective. The

sugar-cane paddy rotation is undoubtedly a poor one from the stand-point of sugar-cane cultivation but paddy is such an important food crop that there is no likelihood of there being any marked change in this regard. Minor rotations which are to be found here and there need not be mentioned.

MANURING.

On approximately three-fourths of the sugar-cane area in Mysore no commercial manure is used. Cattle-manure, sheep-manure (by folding, tank silt, night-soil and to a very small extent green leaf brought in, form the sources of manure supply. Green-manures are practically never used for sugar-cane. On the remaining fourth, oil-cakes are used to a greater or less extent, the chief oil-cakes used at present being honge (3·5—4 *per cent* N.), castor (4—6 *per cent* N.), and groundnut (6—8 per cent N.) The use of cakes as a manure for sugar-cane is undoubtedly profitable where there are no other serious limiting factors. During the years of the War the Agricultural Department made a strenuous effort to popularise the use of oil-cakes in areas where its use was unknown and a total of 1,438 tons was distributed in four years. The very rapid rise in price of these manures owing to the extremely large demand for both oil-seeds and cakes outside of India has seriously checked this work. However, even under the present high price of oil cakes these can still be very profitably used as manures for sugar-cane.

As will be seen the use of commercial fertilisers for sugar-cane is restricted to nitrogenous fertilisers produced in the country. Artificial fertilisers are practically unknown although the Department has given out small quantities of ammonium sulphate for trial. Experiments have just been commenced on one of the Experimental Farms with artificial fertilisers. There is no doubt that with an adequate supply of nitrogenous manures the outturn could be easily doubled. The results of manurial experiments already carried out and given in Table III show this quite clearly. The

TABLE III.

Sugar-cane Manurial Experiments.

Cane crop in tons and Jaggery in maunds per acre. One Maund=28 lbs.

No.	Experiment	1916—17		1917—18		1918—19		1919—20	
		Cane	Jaggory	Cane	Jaggory	Cane	Jaggory	Cane	Jaggory
1	No Cake manure ...	10·7	107	15·52	170	22·25	208	23	239
2	One ton Honge cake ...	19·2	192	20·78	244	Discontinued.			
3	One ton castor ...	20·3	201	24·26	276				
4	Two tons Honge cake ...	21·6	231	25·70	279	34·47	329	34·6	317
5	Two tons castor ...	24·9	271	28·33	328	34·93	326	35·2	311
6	Three tons Honge ...	...	...	...	...	47·46	455	36·5	339
7	Three tons castor ...	...	...	...	...	48·55	468	37·3	341

N. B.—1916-18 Pattapatti. 1918-20 Red Mauritius. All plots were manured with cattle manure at the rate of 30 cartloads per acre.

possibility of making atmospheric nitrogen available to the growers of sugar-cane and other commercial crops is a question which I believe demands study in Mysore where electric power could easily be made available.

PESTS AND DISEASES.

The most serious insect pests of sugar-cane in Mysore are to the various moth borers of which Diatraea sp. seems to be the most important. As already noted, probably the greatest objection to Red Mauritius cane is its greater susceptibility to borer attacks as compared with local varieties. The Entomological Section has had these insects under study for some time. Measures calculated to reduce injury from borers already at least partially worked out are (a) early planting, if possible in January, (b) using heaps of trash in the fields as traps for the moth, and (c) removal of alternate host plants in the wild grasses and sedges which serve as centres of infection. The most important measure is undoubtedly early planting. On the Babboor Farm we are growing practically exclusively Red Mauritius cane on an area of 40 acres. If cane is planted in December and January we find the damage is negligible. If planting is delayed to March or April there is danger of the borers producing a large number of vacancies.

White ants are a serious pest on sugar-cane fields where the water-supply is insufficient or the soil is particularly non-retentive of moisture. The only other pest which has ever been at all worthy of note on sugar-cane is the rice grass-hopper. This has not appeared as a pest during the past seven or eight years. It can be fairly effectively controlled by early sweeping operations on grass bunds and lands in which the eggs are laid.

With regard to fungous diseases, smut (Ustilago sacchari) may do considerable damage to Cheni cane and also attacks J. 33A. to a lesser extent but the thicker canes are practically free. Red rot (Colletotrichum falcatum) which in some other parts of India is looked upon as a serious disease, here makes itself appreciably felt only under unfavourable conditions either of excessive moisture and faulty drainage or on the other hand of insufficient water-supply. We do not consider it a serious disease. Rusts and Leaf-spot diseases are almost entirely confined to Cheni cane where undoubtedly they do some damage. The fungus Hendersonina sacchari has been found on the Hebbal Farm producing the stunted growth described by Butler, but it has not yet been reported from the State in general.

Probably more serious than the damage done by any of the above diseases and pests except borer is that done by pig and jackal. Red Mauritius cane has shown itself much more resistant to attack than the local thick canes and its growth is spreading in many areas where jackal and pig attack is severe.

IRRIGATION.

As already stated, sugar-cane is chiefly irrigated from tanks. Canal and well irrigation are of minor importance in this State. The only immediate possibilities of large increases of areas for sugar-cane lie in the development of one or two sparsely settled irrigated tracts such as the Marikanave area in Hiriyur Taluk, Chitaldrug District, and the area under the Sulekere Tank in Shimoga District. The former commands some twenty four thousand acres but the area which can actually be irrigated has been estimated at about fifteen thousand acres. The latter commands about 4,000 acres. The cultivation of sugar-cane in these two areas is at present very small, largely because of the very sparse population. If the second stage of the Krishnaraja Sagara dam is constructed 120,000 acres will come under irrigation. This would allow for a sugar-cane area of about 40,000 acres. Pump irrigation from our rivers notably in the Western part of the State could lead to a very great increase of sugar-cane cultivation. In addition there is the possibility of

installing electrically driven pumps in suitable areas along the various electric power lines. Demonstrations are at the present moment being carried out by the Electrical Department at Kankanhalli in this connection.

In most parts of the State irrigation water is required throughout the year. In the Malnad, however, this is not the case, the almost continuous rains of June, July and August requiring especially efficient drainage facilities, if the cane crop is to be kept from water-logging. In these areas the cane is little more than a rain-fed crop. The chief hindrance to the spread of sugar-cane cultivation under channels is the intermittent supply of water and even under tanks there would undoubtedly be a very much greater area were the water-supply assured. The construction of subsidiary wells in such cases in a subject which deserves attention.

The number of irrigations and the volume of water given varies very greatly. As already stated, in the malnad the crop is mainly rain-fed. In general, waterings are given every five to seven days during the first three or four months and every ten to fourteen days thereafter. The total supply of water on a well irrigated crop may be taken as 108 to 120 acre inches per annum.

As already pointed out in another connection the supply of water is not the only factor governing the planting of sugar-cane. Another equally important factor is the price of jaggery and a third, which in many parts of the State seems to be the all important factor, is labour supply. Thus under the Marikanave Reservoir, under the Sulekere Tank and generally throughout the Malnad where the population is sparse, cultivators restrict their wet cultivation very largely to paddy, a crop requiring much less trouble and labour.

MANUFACTURE.

The type of mill that is generally used is an iron three-roller mill made in Bangalore or Madras. The old wooden mills have long since been superseded by these. These mills are not generally owned by the cane-growers themselves. Mills and pans are usually hired out by those who keep them for the purpose. In some parts of the State, people with mills and pans and the necessary cattle go round and take on contract the milling of the cane crop or actually purchase the standing crop. The efficiency of these mills leaves much to be desired. According to the tests made by the Department and published in the annual reports as much as 20 to 38 per cent of the juice contained in the cane is left in the begasse. In recent experiments conducted, the extraction from these mills varied from 58 to 67 per cent on the weight of the cane; taking 10 per cent fibre in the variety of cane used for these tests, from 25 to 35 per cent of the juice contained in the cane is still left in the begasse. A new type of mill introduced, the "Nahan" mill made in the Punjab, is more efficient the average extraction being 68 to 69 per cent on the weight of the cane; of course, all the above figures are true only for the variety of cane (pattapatti) used. The capacity of the Nahan is also slightly greater than the mills usually in use in the country and it is much more fool proof.

The kind of pan generally used for boiling the juice is a round one with flaring sides the smallest pans being capable of boiling about 300 lbs. of juice. In an average size of pan about 600 lbs. of juice are boiled. The methods of liming vary to a great extent. In the Malnad, where mostly semi solid jaggery is manufactured, the juice is not limed at all. In the districts of Bangalore and Kolar, very great care is taken about liming, and the jaggery produced is generally of a light colour with good keeping qualities. Lime is used as a fairly thick cream. In some parts of the Mysore District, very thin lime cream is used. Powdered lime is also used in some parts of the State.

Skimming is resorted to mostly where jaggery of good light color is produced, that is, in the Districts of Bangalore and Kolar. In the Mysore District which produces mainly dark jaggery skimming is done only when jaggery is made specially for domestic consumption.

In making jaggery the single furnace system is usually adopted. Begasse and trash are used as fuel for evaporating the juice. The available quantity of these two not being sufficient for the purpose, firewood is also used in small quantities to supplement them. Experiments conducted to find out the quantity of fuel needed have shown that one ton of good dry fuel (fire wood) is needed to boil down 6,000 lbs. of juice containing 20 per cent solids in solution. Attempts have been made to construct a simple form of multiple furnace with a view to utilize the heat of the waste gases and some fuel. So far as the present results go, the new system of multiple furnace has not shown any reduction in the fuel used, though there are other advantages in its favour. The multiple furnace system makes skimming easier and renders it possible to filter the syrup without much difficulty, thereby improving the colour of the jaggery produced.

The introduction of power mills for crushing sugar-cane has not met with any conspicuous success in Mysore. Various reasons have been assigned for this but one of the chief is undoubtedly the difficulty experienced in handling the large amount of juice turned out by a 12" x 18" three-roller mill. Such a mill does about ten times as much work as the ordinary bullock mill. The open pan system—no matter what kind of furnace is used-does not appear to be suited for working up this large quantity of juice into good jaggery and it is, to say the least, difficult to maintain good colour and quality in the jaggery when dealing with such large quantities of juice. Boiling by means of steam would undoubtedly greatly lessen the difficulties but a suitable steam plant has yet to be introduced.

Central Factories.

The question of Central Factories in Mysore is one that could be taken up on only one or two isolated areas. If the second stage of the Krishnaraj Sagara dam is completed there may be a chance for a sugar-cane factory in some place in the tract which will come under irrigation. There are, as far as I am aware, only two irrigated tracts at present existing where there is any chance for a sugar factory. These are the Marikanave tract and the Sulekere tract. In both of these, sugar-cane is at present an insignificant crop so that should a sugar factory be established in either of these places it would not have to compete with jaggery. The only place at present existing where a central factory crushing 500 tons a day could be established is the Marikanave area. The Department has been growing cane in this tract for the past three years and the results obtained indicate with proper cultivation and manuring yields of 30 tons per acre of Red Mauritius cane can be obtained after the land has been brought into fairly good condition.

I have given a general account of the present position of sugar-cane cultivation in the State and certain recommendation with regard to its improvement and extension. I now propose to discuss more definitely measures calculated to increase our outturn. As already pointed out the extent of our sugar-cane area and the outturn therefrom are largely controlled by three factors, namely irrigation, capital and labour supply. With regard to irrigation little need be said more than again to point out that if the schemes at present on hand are carried through we should be able to double our area under sugar-cane without any trouble. Even with our present irrigation facilities I believe that a large increase in area is possible if only the other conditions are met.

The lack of capital is undoubtedly a very important factor controlling not only area but outturn. Many agriculturists are deterred from planting sugar-cane because they have not the capital to spend on manure without the application of which sugar-cane ceases to be a particularly profitable crop. Even those who do apply oil-cakes to sugar-cane rarely put on anything like the most profitable amount. When we recall that on approximately three-fourths of our sugar-cane area no manure other than the local supplies of cattle manure, tank silt, etc., are applied and that the application of oil-cake will give a return of 100 per cent on the money invested we can see what immense scope there is for work in this direction.

Three ways lie open for the financing of manure supply in the State:—firstly, through the takkavi loan system, secondly, through co-operative credit and thirdly, through the Agricultural Department. Of these only the last has been utilized to any extent in the past. The work of the Agricultural Department has, however, had for its object, not the supply of manure on a large scale to sugar-cane growers, but rather the teaching of sugar-cane growers in as many areas as possible by practical demonstration the value of oil-cakes for sugar-cane. Its work has, therefore, been extensive not intensive. Nor do I think that the Agricultural Department should do more than this. If oil-cake supply is to be organized on a large scale, as I think it should be, some other agency will have to be found. The natural agency is, I believe, the co-operative organization but it will, in my opinion, be some considerable time before co-operation will be sufficiently advanced in this State to be able to take up this work in an efficient manner. The takkavi system appears to me the best calculated to give immediate results if some means can be devised to speed up operations. The chief obstacles in the way of utilizing takkavi loans for such purpose are (a) the long time which usually elapses between the application for a loan and the granting of the loan, and (b) the tendency for a portion of the loan to evaporate before it actually reaches the hands of the man to whom it has been granted. I believe that both of these obstacles could be removed. To remove the first obstacle I would suggest, as an experiment at least, that an officer should be placed on special duty in an impoatant sugar-cane growing District for say six months (*i.e.* from November to April) to investigate loan applications and make definite recommendations with regard to them. A District Economic Superintendent should, with the experience he has gained, be a very suitable man for such work and I can conceive of few lines of activity in which he could obtain more practical results. With regard to the second obstacle I believe it could be entirely removed if instead of the loan being given in cash it should be given in the form of manure supplied through the agency of the Agricultural Department on an order from the Revenue authorities.

That energetic steps should be taken to utilize to the full our supplies of oil-cake is only too evident. During the past six months large quantities of oil seeds have been crushed in the State the cake from which has gone to Ceylon and Java. If the planters of Ceylon and Java can use this cake profitably after paying transportation charges in addition to a high initial price surely with the high prices for jaggery which at present rule and which are likely to rule for some time to come our sugar-cane growers should be able to utilize it profitably. There are, in my opinion, few questions of more pressing agricultural importance than the question of the local utilization of our oil-cakes, the export of which forms at present probably the most serious drain on our agricultural resources.

I do not wish these suggestions to be looked upon as an attempt at a final solution of the problem. That final solution must

obviously rest with the development of co-operative activity but surely it would be a short sighted policy for us to sit with folded hands until such time as the co-operative movement is ready to take up this work. What we have to do is so to develop a demand for these manures as to make the formation of special societies for their purchase and distribution a possibility.

While the most striking increase in outturn of sugar-cane can undoubtedly be produced through the application of nitrogenous manures that is by no means the only way in which yields can be increased. The selection of varieties, and the improvement of methods of cultivation are also important.

As already pointed out the Agricultural Department has for some years been organizing the introduction of Red Mauritius cane into practically all parts of the State. The most marked success has been achieved in the Western part of the State where the variety usually grown is a comparatively poor yielder and where damage from pig and jackal is likely to be severe. In this part of the State there are now about 1,000 acres under Red Mauritius cane as a result of the Agricultural Department's actiuities. In the Eastern part of the State, Red Mauritius is not yet and is not likely to become so popular. In Bangalore and Kolar Districts where the cultivation of sugar-cane is on a higher level than in any other part of the State the local Pattapatti does very well. It is a cane which reqnires good cultivation and heavy manuring to give good results. Even under these favourable conditions it is not so heavy a yielder as Red Mauritius but it has two good points which the latter does not possess. In the first place it is a soft cane and is therefore more easily milled while it can be sold as a chewing cane, the most profitable method of disposing of cane near large centres. In the second place it produces a lighter coloured jaggery a feature which is considered of particular importance in these districts.

We see then that while Red Mauritius is at least for large areas of the State a very distinct improvement on the indigenous varieties it is by no means the ideal cane for Mysore. Certain seedling canes which have been raised from it promise to approximate much more closely to the ideal than does Red Mauritius, and should their early promise be fulfilled on a field scale we shall soon have canes for general introduction which should meet the needs of the great majority of sugar-cane growers in the State. An increase in yields of 25 per cent through the introduction of improved varieties is I believe quite a modest estimate. In many parts of the State Red Mauritius is already giving increases much in excess of this.

The last obstacle to be discussed in the way of sugar-cane cultivation is the scarcity of labour. Sugar-cane is a crop requiring very much more labour than almost any other crop grown in the State. Even with the introduction of every possible labour-saving device it will remain so. Where therefore as under the Marikanave and Sulekere Reservoirs we have large stretches of land either uncultivated or very indifferently cultivated the only chance for the extension of sugar-cane cultivation in the near future seems to be through the establishment of large plantations which will be able to organize a labour supply from outside. In many areas, however, where the labour difficulty is not so acute much could be done to reduce the labour amount per acre and so extend the area of sugar-cane cultivated. Bullock power is not used in sugar-cane cultivation to nearly the extent that it could be, and the substitution of an iron plough for the wooden plough now generally used in preliminary cultivation would result in a saving of at least half the time devoted to this work. This would enable sugar-cane growers to put in much larger areas than they are now doing. The time devoted to weeding and other after cultivation could also be greatly economised. Our

experiments go to show that with moderate manuring the sugar-cane rows can be profitably put four feet apart instead of 1½ feet apart as is now a common practice (see Table IV). With rows four feet apart cane can be intercultivated by bullock power at least till

TABLE IV.

Sugar-cane Spacing *Experiments.*
Cane crop in tons and jaggery in maunds (28 lbs. each) per acre.

Experiment	Local Pattapatti Cane						Red Mauritius Cane			
	1915—16		1916—17		1917—18		1918—19		1919—20	
	Cane	Jaggery	Cane	Jaggery	Cane	Jaggery	Cane	Jaggery	Cane	Jaggery
Rows 1 foot apart ...	29.5	284	20·1	209	25·28	298	Discontinued		...	...
,, 2 feet ,, ...	38·0	364	19·1	221	26·98	314	40·52	407	34·3	313¾
,, 3 ,, ,, ...	32·7	315	21·3	233	33·70	334	42·53	419	35·6	326
,, 4 ,, ,, ...	...	...	...	...	...	...	44·64	429·4	36·2	326¼

N. B.—All plots were manured at the rate of 30 cartloads cattle manure and 1 ton of Groundnut cake per acre.

it is four months old. Lastly with a harder variety and one less liable to lodge than Pattapatti it is quite possible to do away with all wrapping, another operation requiring a great deal of labour and involving much expense. I believe it is no exaggeration to state that through the use of bullock drawn implements double our present sugar-cane area could be cultivated with the man power which is now being devoted to this work.

Lastly, of course, the labour employed in the manufacture of jaggery both of man and of bullocks could be very much economised through the introduction of power crushing plants.

The great desideratum of the Mysore Agriculturist is capital. Without this very little agricultural development can take place. The permanent source of that capital must be the crops grown on the land. There is no crop now grown in Mysore which can be made to produce capital so quickly and so abundantly as sugar-cane and there is no period of our agricultural history which has been so favourable for the development of sugar-cane cultivation as the present.

THE WORLD'S SUGAR SUPPLY.*

By Wynne Sayer, Secretary,
Sugar Bureau, Pusa.

I. Introduction.

It has been very truly said that there are lies, damned lies, and statistics and to such an extent does the truth of the above saying prevail that this article is written with a view to putting before the general public, who may not be familiar with the exact state of things, the facts and figures dealing with the present world shortage of sugar, the reasons for the shortage and the possibility of its continuance. Here in India, while we are not really feeling the acuteness of the situation, like those in England, yet we have the opportunity of realizing that India, despite the fact that she has the largest acreage in the world under cane, still requires to import an amount of sugar equal to the entire surplus of the other British sugar growing dependencies to supply her own needs while England who has no means of supplying her own needs other than that of buying from abroad is now rationed on the most rigid scale (the consumption for 1920 being limited to 1,160,000 long tons) owing to the fact that the extra sugar she requires is held against her at exorbitant rates. This will undoubtedly bring home to England the necessity for organizing her sugar growing dependencies so that such a state of things may not occur again.

When speaking of the world's sugar consumption what is really meant is its sugar production; for although in normal times a considerable quantity of sugar, some 760,000 tons, is carried over the year in stock, yet consumption has expanded to the extent of this margin in the last few years and in consequence the shortage has directly affected consumers rather than reserve stocks. In order to realize the importance of sugar as a diet among civilised nations and the extent to which its consumption is increasing each year the following table of the world's production of sugar excluding British India may be studied and from the figures contained therein it may be safely said that at no time in the near future is the supply likely to overtake the demand.

TABLE I.

World's Production of Sugar excluding British India.

Year	Total production
	Tons.[1]
1859-60	1,792,564
1864-65	1,976,727
1869-70	2,587,215
1874-75	3,206,221
1880-81	3,847,786
1884-85	4,904,400
1889-90	5,674,700
1894-95	8,257,200
1899-1900	8,291,800
1902-03	9,372,600
1904-05	9,646,000
1909-10	12,765,000
1911-12	13,349,000
1913-14	16,302,800
1914-15	15,920,700[2]
1915-16	14,021,500
1916-17	14,028,600
1917-18	13,976,500
1918-19	14,081,600

[1] A ton = 2,240 lbs.

[2] The decrease in the world's production since 1914-15 is due to the war and its after-effects.

* With acknowledgments to the *Indian Trade Journal*.

II. Sources from which sugar is derived.

Sugar, the sucrose or saccharose of the chemist, is widely distributed in the vegetable kingdom. In a great many plants it represents the most important carbohydrate reserve substance. But sugar-cane and sugar beets are the chief sources from which sugar is manufactured. Certain species of the palm, the maple and sorghum also yield sugar but they are of secondary importance as being responsible for a very small quantity compared with the total output of this product from the two plants mentioned above. It is well known that sugar has been made since pre-historic times from cane which is a native of the tropics and which cannot grow outside a sub-tropical climate. Because of climatic conditions the cultivation of cane by white labour is even yet scarcely possible and was quite out of the question until modern tropical sanitation developed. It should be remembered that every additional ton of cane sugar means either the replacing of inefficient by efficient methods of cultivation or manufacture, or the reclamation of tropical forests to the uses of man. The conditions under which sugar-cane is raised vary greatly in the different cane growing areas of the world. In Hawaii the most modern machinery is used both in cultivation and manufacture. Much of the land is broken with steam ploughs, irrigation on a scientific scale is practised and up-to-date processes of manufacturing sugar are employed. In the favourable conditions of Cuba sugar-cane grows like a weed and very little care is required. On the western side of this island four to seven ratoons are grown while on the eastern side twenty to forty ratoon crops are taken. In Java the cane is planted every year and grown on an intensive scale with scientific skill and care. Sugar-cane cultivated under favourable conditions, *e.g.*, in Java, gives a crop of over 40 tons per acre with a sucrose content of 11 to 16 per cent. Factories equipped with up-to-date machinery and working under skilled supervision in Java extract about 4·2 tons of sugar per acre. It should be mentioned, however, that yields as high as 7 tons of sugar per acre have been obtained in isolated cases and the application of science and improved processes of manufacture are continually raising the outturn of sugar per acre.

The next principal source from which the world's supply of sugar is derived is beet. The history of beet-root sugar dates from 1747 when the Prussian Chemist, Marggraf, obtained sugar crystals from beets experimentally. The first beet sugar factory was started in Silesia in 1801. Since then the progress of the industry has been very rapid. The cultivation of this root crop has spread practically throughout the countries of Europe and into the United States of America. The most scientific methods have been adopted both as regards cultivation and manufacture and new varieties of the beet, high in sugar content, have been developed. It may as well be made clear here that while the sugar content of beet as now grown is higher than that of cane, the crop is a lighter one. The average yield of sugar beets in the United States is 9½ to 10½ short tons per acre; in Germany 12½ to 14½; Austria-Hungary 11¼ to 12¾; Russia 6¾ to 8¾; in short, on an average, under the best conditions, only about 12 to 20 long tons of beets can be grow per acre and thus the yield of sugar seldom reaches 2 tons per acre.* It is, however, a shorter duration crop and is one which can be worked in a most useful rotation.

The progress of this industry, aided on the continent by protective duties and later by the grant of direct or indirect bounties on

* The average recovery of sugar from sugar beets in the United States is 13 per cent to 14¼ per cent in refined sugar, equal to 14¾ per cent to 15½ per cent in raw sugar; in Germany 15¾ per cent to 16½ per cent in raw; Austria-Hungary 14½ per cent to 15¼ per cent; Russia 12 per cent to 16 per cent. Truman G. Palmer.

the exportation of beet sugar, was very striking. In 1840 beet sugar was but 4 per cent of the total sugar supply of the world. By 1870 it had become 34 per cent of the total. Between the eighties and nineties it rose to 50 per cent while in the next ten years beet sugar constituted ⅔ths of the world's total output of sugar. Towards 1898-99 the dominating position of the beet sugar industry threatened ruin to its rival, the cane sugar industry. As a result of various international conferences the Brussels International Sugar Convention was signed and came into force in 1903. By it all bounties, etc., were abolished and the two industries were placed on an equal footing as regards competition. Since then, the increase in cane sugar production has been very rapid as will be seen from the table below:—

TABLE II.

World's Production of Cane Sugar excluding British India.

Year.	Tons.
1904-05	4,776,000
1909-10	6,177,000
1911-12	6,548,000
1913-14	7,602,700
1914-15	7,705,100
1915-16	8,041,700
1916-17	8,507,130
1917-18	8,991,250
1918-19	9,686,960

(Willett and Gray)

III. COUNTRIES PRODUCING CANE SUGAR.

The production of cane sugar is widely distributed throughout the areas of the world.

The following table shows the countries and also gives the figures in long tons of cane sugar production during the years 1913-14 to 1918-19.

TABLE III.

—	1913-14	1914-15	1915-16	1916-17	1917-18	1918-19
Louisiana	261,300	216,700	122,800	271,339	217,499	250,802
Texas	7,000	3,500	1,000	6,300	2,000	3,125
Porto Rico	325,000	308,200	431,300	448,567	405,174	375,000
Hawaiian Islands... ...	550,000	577,200	529,900	575,510	515,035	535,000
Cuba *crop*	2,597,700	2,592,700	3,007,900	3,023,720	3,446,083	3,971,766
St. Croix	5,800	4,500	14,800	7,787	5,400	9,000
Philippine Islands, *exports*..	225,000	243,000	332,200	202,655	216,260	192,000
San Domingo, *exports* ...	105,800	108,500	126,100	130,171	127,332	158,309
Mexico, *crop*	130,000	110,000	65,000	50,000	40,000	60,000
Central America	22,000	22,000	35,000	25,000	25,000	30,000
Trinidad	47,300	49,100	64,200	70,891	45,256	47,850
Barbados, *exports* ...	33,400	32,600	65,000	55,456	65,230	80,000
Jamaica, *exports*	15,600	15,100	15,100	28,331	34,300	40,000
Other West Indies ...	24,000	24,000	35,400	40,000	35,000	29,300
British Guiana, *exports* ...	103,800	113,600	116,200	101,650	114,007	93,902

TBBLE III.—*contd.*

——	1913-14	1914-15	1915-16	1916-17	1917-18	1918-19
Queensland and N. S. Wales.	225,000	246,400	159,700	192,831	325,900	226,000
Fiji Islands, *exports* ...	100,000	102,000	90,000	95,000	70,800	80,000
Egypt, *crop* (consumed locally)	69,400	75,200	99,000	101,832	79,450	82,000
Mauritius, *crop*	249,800	277,165	215,500	209,035	249,400	278,555
Natal, *crop*	85,700	91,600	111,965	125,000	106,250	144,000
Martinique, *exports* ...	38,700	40,000	39,900	34,443	20,881	30,000
Guadaloupe	38,900	40,000	34,100	36,160	28,000	25,000
Reunion, *exports*	35,800	39,300	45,000	42,152	50,000	50,000
Dutch Guiana	14,000	12,000	13,000	12,000	10,000	8,000
Java	*1,345,200*	*1,303,000*	*1,198,600*	*1,596,174*	*1,778,345*	*1,749,400**
Venezuela	3,000	3,000	7,000	18,428	15,000	15,000
Ecuador	...	...	7,600	7,000	8,000	7,000
Peru	176,700	175,000	250,000	276,000	265,000	250,000
Argentina	280 300	330,000	149,300	87,700	87,700	130,260
Brazil	203,400	240,000	194,000	150,050	148,958	260,000
Formosa and Japan, *crops*...	204,000	262,000	405,200	436,026	397,618	415,678*
Mozambique, *crop* ...	34,000	40,000	50,000	55,000	50,000	50,000
Spain	13,200	7,400	6,400	4,584	7,040	6,610
India (raw sugar)	*2,291,500*	*2,460,600*	*263,400*	*2,728,000*	*3,311,000*	*2,337,000*
Total tons ...	9,894,200	10,165,700	10,675,700	11,235,136	12,302,250	12,023,890

(Willett and Gray.)

* Java in 1919 only totalled 1,335,000 tons and Formosa 289,500 thus reducing the total by 500,000 tons and eliminating the effect of Cuba's increase on world's supply of cane sugar.

In India sugar-cane occupied 2,820,000 acres in 1918-19, but the total production of raw sugar was estimated at only 2,337,000 tons. It should be borne in mind that by far the largest amount of the product manufactured in this country is jaggery, a form of raw sugar, and is consumed as such. Raw sugar as ordinarily understood can be refined at a loss of 7 per cent but the jaggery or raw sugar manufactured in this country is so bad that out of every 100 tons of this product you can get hardly 47 tons of refined sugar, the rest being all molasses and waste. I do not think that figures regarding India's total production of jaggery should be included in the world's figures of sugar production as they merely confuse the main issue. Consumers of this raw sugar (jaggery) in India do not use refined sugar so that even if there is a shortage in this jaggery crop it

does not add appreciably to India's demand for white sugar. She turns out about 125,000 long tons of refined sugar and these figures should be included in the world's total. There is however an increasing number of people who consume white sugar in this country and this consumption is much greater than India's production of this article; hence before the war (*i.e.*, during the five years 1908-09 to 1913-14) she imported on an average 633,500 tons of sugar valued at Rs. 12,50,97,000 principally from Java, Mauritius and Austria-Hungary. On account of the difficulties caused by the war the imports have fallen off. Last year they stood at 506,700 tons valued at Rs. 15,36,81,000. The demand for sugar is however increasing and the imports will show signs of recovery and even advance further if the prices show some reduction from their present abnormally high level.

Among cane sugar producing countries Cuba with its total output of nearly 4 million tons of raw sugar stands first, next comes Java with over 1,300,000 tons. As the area under cane in Cuba is not estimated to be higher than in India while the acreage under this crop in Java is hardly one-seventh of India's it is pretty obvious that the methods of growing and manufacture in those countries are carried on on more economical and productive lines.

IV. Countries Producing Beet Sugar.

The following table shows the beet sugar producing countries of the world and their output from the year 1913-14 to 1918-19.

TABLE IV.

Countries of production	1913-14	1914-15	1915-16	1916-17	1917-18	1918-19 Estimates
Germany	2,676,000	2,524,000	1,575,000	1,477,000	1,541,000	1,441,900*
Austria-Hungary (Czecho—Slovakia, etc.)	1,662,000	1,594,000	924,200	920,400	668,250	700,000
France	768,800	290,400	148,300	203,800	200,265	110,096
Russia (Ukraine, Poland, etc.) ...	1,662,000	1,909,000	1,641,000	1,304,000	1,028,580	700,000
Belgium	225,400	157,500	111,300	132,900	131,000	75,000
Netherlands	227,800	290,400	239,000	261,800	199,300	173,430
Sweden	135,100	151,600	125,300	116,200	125,000	127,467
Denmark	143,400	147,700	123,000	112,200	136,000	144,600
Other European Countries ...	534,300	492,200	295,300	246,100	261,000	255,000
United States of America ...	655,300	646,300	779,800	734,600	682,860	674,892
Canada	10,000	12,500	17,600	12,500	11,250	22,300
Total tons ...	8,700,100	8,215,600	5,979,800	5,521,500	4,985,300	4,394,700

(Prinsen Geerlings and Willett and Gray.)

* More recent data are to the effect that production did not exceed 1,250,000 tons W. S.

In 1913-14 beet supplied 46 per cent of the total sugar crop of the world. Since then it has steadily decreased to date. In 1919 it was only 27 per cent of the total. The principal beet growing countries in Europe are Germany, Austria-Hungary, Russia and France* and outside Europe, the United States of America. All the beet growing countries of Europe have been hit heavily by the war.

In France out of the 206 factories existing before the war only 61 could work in 1919. In all the European countries the indirect consequences of the war have brought about a decline in beet sugar production, *viz.*, scarcity of food stuffs and fodder, shortage of labour, implements and fertilizers, and lack of coal. The output per acre of the planted area and the sugar content have also deteriorated as a result of these conditions. Given favourable circumstances it will be several years before the European beet sugar industry will be able to regain its former position and until the cane sugar industry is able to meet this deficit the world will suffer from a shortage of sugar.

V. The World's Production and Consumption of Sugar.

Reference to tables III and IV will show the total world's production of both beet and cane sugar excluding British India† to be as follows:—

TABLE V.

Year	Long tons.
1913-14	16,302,800
1914-15	15,920,700
1915-16	14,021,500
1916-17	14,028,636
1917-18	13,976'500
1918-19	14,081,600$

* These four countries are to be understood to include here all the territory which belong to them before the Great European War of 1914-18

† British India is left out as her main sugar crop excluding her white sugar manufacture of 125,000 tons does not affect the world crop either way but if included merely clouds the main issue.

$ As already mentioned in footnote to Table III, Java fell short by 400,000 tons and Formosa by 100,000 in 1919 which resulted in the world supply of sugar being actually less in that year than in 1916.

Before the war (*i.e.*, during the quinquennium 1908-09 to 1913-14) the principal importing countries of the world were the United Kingdom, (1,811,450 tons), the United States of America (2,603,100 tons), and India (633,500 tons), while the principal exporting countries were Cuba (2,396,700 tons), Java (1,234,500) Germany (662,600 tons), Austria-Hungary (734,100 tons), Russia (203,250 tons), Mauritius* and Belgium.†

Of the exporting countries in Europe, Germany, Russia Austria-Hungary and France have ceased to fulfil that role. Germany's consumption in 1919 was estimated at 1,650,000 tons while her production of sugar was only 1,250,000 tons, leaving a deficit of 400,000 tons to be imported. On account of the great shortage of labour and artificial manures, one hundred and sixteen thousand acres less have been sown in 1919 than in 1918 and she will require this year not less than 500,000 tons as imports if she can pay for them. In Italy the 1919 crop showed an increase of 50,000 tons over 1918 but this was only just sufficient for her requirements. The area planted for the 1920 crop is greater than the acreage in previous years but the removal of restrictions on consumption of sugar may take away the extra quantity.

Crops in Sweden, Poland, and Spain promise to be sufficient for home needs. Norway produces no sugar within its borders and is dependent on imports for its supplies. For the year 1919 the Inter-Allied Council allotted 66,000 tons to meet its needs. Originally Germany, Austria-Hungary, Russia and Java used to supply this but during 1919 the United States of America and Java were laid under requisition. This year 75,000 tons will be required. Regarding Russia no reliable information is available

* Mauritius exported on an average 128,800 tons of sugar to British India alone during the five years 1908-09 to 1913-14.

† Belgium exported 171,740 tons in the year 1913

but in view of the conditions prevailing there any exports are still out of the question. Her pre-war consumption was 1,180,000 tons and production 1,403,000 tons, leaving over 220,000 tons for export. But her total output of sugar in 1919 was estimated at 700,000 tons while this year the estimate is only 350,000 tons. Austria-Hungary's production before the war was roughly 1,400,000 tons with a local consumption of 683,000 tons and thus she was in a position to export over 700,000 tons. But at present the conditions in German-Austria are hopeless. In Hungary where formerly the export of sugar was considerable it is not expected that even one-third of the country's requirements will be produced in view of the utter collapse of her political and economic organization. Only Czecho-Slovakia is in a position to meet its own requirements of 350,000 tons and to report a surplus of 150,000 tons. France used to consume 645,000 tons on an average before the war and her production was 670,000 tons a year. But in 1919 her production fell to 110,000 tons of refined sugar and she imported 440,000 tons. The 1919-20 crop is estimated at not more than 160,000 tons and as the taste for sugar and sugared preparations has considerably increased she will require over 600,000 tons as imports. At the present moment the only countries in Europe able to supply beet sugar in any quantities are Holland, Denmark and Czecho-Slovakia. The first named country (Holland) expects to export 50,000 tons; the Danish crop for 1919-20 is expected to yield 160,000 tons. About 30,000 tons will be available for export as at 130,000 tons the per capita consumption of Denmark is among the heaviest in the world. As regards the position of Czecho-Slovakia the extent of her capacity for exports has been considerably reduced by the unseasonable setting in of severe cold weather, accompanied by heavy snow. Most recent advices put down the crop at 500,000 tons (metric) against 750,000 previously estimated. From the point of view of net exports therefore we are left with Cuba, Java, and Mauritius as the principal countries to look to, while Germany, France, German-Austria, Hungary and Russia, to the extent to which their finances will enable them to buy sugar must join the importing countries to the tune of some 1,500,000 tons.

Cuba's production was 2,597,700 long tons in the year 1913-14 and her consumption was 200,000 tons but since then her production has increased by leaps and bounds. It rose to 3,446,000 tons in 1917-18, and to 3,971,000 tons in 1918-19 and the crop in 1919-20 is estimated at 4,500,000 tons. It may however be mentioned in passing that this 500,000 tons increase if it eventuates will be swallowed up by those countries who are now rationed, *e.g.*, England who is now short of 700,000 tons on her pre-war consumption alone.

		Long tons.
Cuba's exports in 1914-15 were	...	2,417,524
„ 1915-16 „	...	2,850,197
„ 1916-17 „	...	2,885,510
„ 1917-18 „	...	3,280,798
„ 1918-19 „	...	3,834,818

Before the war 94 per cent of her exports used to go to America but since 1914 other countries, especially Great Britain, France and Canada have been taking a considerable portion. Stocks at shipping ports on 15th November 1919, were 180,623 tons against 238,637 *tons in 1918 and 22,174 tons in 1917.

Porto Rico and Hawaii export practically all their sugar to the United States of America. Before the war America used to import the greater part of the sugar produced in the Philippine Islands. But the exports to Hongkong, China, Japan and the United Kingdom have since increased. In 1917-18 while the United States of America took 66,421 tons, other countries took 149,839 tons. In 1918-19 while 80,000 tons went to the United States of America, 115,000 tons were shipped to other countries.

Java's production in the year 1913-14 totalled 1,345,000 tons. She exports practically all of her sugar crop, and her exports in 1913-14 were 1,272,410 tons. Her principal customers were India, Hongkong and Japan. Since then European countries have begun to take heavily. This country reached its high water mark of production in 1917-18 when the crop totalled 1,778,345 tons. Her exports rose to 1,688,400 tons in the year 1918-19 (year ended 31st March, 1919). In the season May to November of 1919 her crop totalled 1,335,000 tons. The stock on 1st April, 1919, was 316,117 tons and the 1919 crop brought the totalled supply up to 1,651,950 tons. Of this quantity the exports from April 1st to October 31st, 1919, came to 978,614 tons and the estimated balance of supply on November 1st was 638,336 tons.

In Mauritius the average production for the five years 1913 to 1918 was 252,000 tons out of which 5,904 were used for local consumption, the rest being exported. Exports from 1st August, 1918, to 4th July, 1919, from the 1918-19 crop and the previous year's balance were 260,352 tons against 197,256 tons in the previous year.

Exports were as under :—

August 1st to July 4th.

(in long tons)

Destination		1918-19	1917-18	1916-17
Great Britain	...	154,135	133,627	7,952
France ...	...	11,216	...	151,760
Belgium ...	...	11,431	...	12,028
India ...	...	70,526	47,528	22,249
Australia...	...	7,094	...	...
Elsewhere	...	5,950	16,101	1,764
		260,352	197,256	195,753

The shipments under "Elsewhere" were mostly to African ports. The 1919-20 crop is estimated at 242,000 tons. An event of primary importance to Eastern markets has been the purchase, by the British Royal Commission, at about £ 50 per ton *f. o. b.* Mauritius of the 175,000 tons of crystal sugar controlled by the Mauritius Planters' Syndicate.

Turning to the importing countries we will take the United States of America first.

For the five years 1909 to 1913 the United States consumed an annual average of 3,390,000 tons of sugar. During the last ten years roughly half the quantity of her total supplies came from Cuba, one-fourth from Porto Rico, Hawaii and the Philippines, and one-fourth from her domestic production which consists of both cane and beet sugar.[1] The amount which came from other countries was negligible. The United States of America import raw sugar from Cuba and refine it for domestic consumption as well as for export and the average exports of this refined sugar came to 48,800 long tons a year before the war. Since then they have considerably increased, reaching a total of 407,140 long tons in 1918-19. Although the exports have increased the supply of sugar has also so expanded that the consumption has steadily been above the pre-war average. During the first nine months January to September, 1919, 3,263,000 long tons refined sugar was delivered into domestic consumption in the United States of America as against 2,661,000 tons in the same period in 1918, an increase of 22 per cent and this is entirely independent of its exports which came to 504,000 tons including the British Royal Commission's shipments. The net consumption during the whole of 1918, (January to December) was 3,400,000 long tons while for the whole year 1919 it must have been four million tons. In this connection it will be interesting to note that the total production of the United States of America and her insular possessions (Hawaii, Porto Rico and the Philippines) in 1918-19 was only two million and odd tons. The American consumption of sugar has

[1] For the quantity of beet and cane sugar produced in the United States of America reference should be made to tables III and IV.

greatly increased. This is shown in the heavy increased sales of candy, soft drinks, ice cream, etc. Prohibition of the use of beer and spirits, general prosperity of the country and the desire of the trade to lay in stocks at present prices are also factors in the increased consumption. The entire amount of sugar exported from January to end of September, 1919, represented only two weeks' supply for the country as a whole.

Before the war Germany and Austria-Hungary between themselves used to supply over half of the United Kingdom's requirements. On account of the stoppage of supplies from this source during the war Great Britain began to import from Cuba, Mauritius and Java. In 1918 Cuba alone furnished 823,900 tons of sugar, that is, more than three-fifths of the United Kingdom's total sugar imports of the year. In spite of these increased imports from the New World, her total sugar supply decreased from 1,811,000 tons before the war to less than 1,310,000 tons in 1918. The total imports in the first nine months of 1919 however were 1,271,231 tons and consumption during the same period amounted to 1,072,129 tons and she is now rationed to 1,160,000 tons for the whole of the year 1920. It may be mentioned that in 1919 less than 20,000 tons of the total imports of sugar into the United Kingdom came from the continent, over 400,000 tons from Cuba, 225,000 tons from Java, 150,000 from the United States of America, 135,000 tons from Mauritius, and 92,000 tons from the West Indies.

India was Java's principal customer before the war, taking an average of 453,000 tons, *i.e.*, more than a third of the total sugar exported by Java. Since then, however, other countries have come to occupy an important place in Java's export sugar trade, notably Japan and European countries. Japan which took 49,905 tons in 1916, purchased 328,745 tons in 1918, and the direct result of this was the rise in price of sugar in India, as the sugar which used to go to India was now wanted for China and other countries. Japan bought not only for home consumption but also for other countries, particularly for America on account of the extra amount of tonnage she had available. In 1918-19 India imported 425,200 tons of Java sugar, (363,100 tons coming from Java and 62,100 tons from the Straits Settlements.) In 1919 shipments to Europe increased as the result of the releasing of ships from the war carrying trade.

VI. The Situation at Present.

The world's total sugar crop for 1919 excluding British India was estimated at 14 million tons, *i.e.*, nearly two million tons less than that of 1913-14 and 1914-15. According to Messrs. Willett and Gray's estimates, if we exclude British India, the world's production of sugar in 1919 was level with that in 1918. But it is well known that in 1919 there was a very severe shortage of sugar and prices touched unheard of figures. This was due to the increased consumption in America and European countries as a result of the relaxation of restrictions on sugar with the cessation of the war and the actual failing off in production in some countries *e.g.*, Cuba's estimated production of 4,000,000 actually came to 3,971,776 tons while Java's estimated crop of 1,700,000 tons came to 1,335,000 tons only. The actual production in Formosa also was only 298,500 tons against the estimate of 415,678 and all this resulted in the serious shortage actually felt in the year.

Messrs. Willett and Gray have published their estimate for the season 1919-20, which is given below.

TABLE VI.

(I) Cane Sugar.

	Harvesting period.	1919-20 tons.
United States-Louisiana ...	Oct.-Jan.	[1] 116,000
Texas	Oct.-Jan.	2,000
Porto Rico	Jan.-June	426,600
Hawaiian Islands ...	Nov.-July	500,300
West Indies—Virgin Islands	Jan.-June	12,000
Cuba	Dec.-June	4,300,000
British West Indies-Trinidad	Jan.-June	65,000
Barbados	Jan.-June	70,000
Jamaica	Jan.-June	50,000
Antigua	Feb.-July	12,000
St. Kitts	Feb.-Aug.	11,000
Other British West Indies ...	Jan.-June	10,000
French West Indies-Martinique, *exports* ...	Jan.-July	30,000
Guadeloupe	Jan.-July	25,000
San Domingo	Jan.-June	180,000
Hayti	Dec.-June	5,000
Mexico [1]	*Dec.-June*	[2] *85,000*
Central America ...	Jan.-June	30,000
South America-Demerara *exports*	Oct.-Dec. and May.-June	80,000
Surinam	Oct.-Jan.	12,000
Venezuela, *exports* ...	Oct.-Dec.	18,000
Ecuador	Oct.-Feb.	7,000
Peru	Oct.-Feb.	250,000
Argentina	May-Nov.	250,000
Brazil	Oct.-Feb.	175,000
Total in America ...		6,721,600
British India (consumed locally)	Dec.-May	2,800,000
Java (1920-21, 1,600,000 tons estimated.)	May-Nov.	[3] 1,335,763
Formosa and Japan ...	Nov.-June	300,000
Philippine Islands ...	Nov.-June	225,000
Total in Asia ...		4,660,763
Australia	June-Nov.	275,000
Fiji Islands	June-Nov.	60,000
Total in Australia & Polynesia.		335,000
Egypt (consumed locally) ...	Jan.-June	90,000
Mauritius	Aug.-Jan.	242,000
Reunion	Aug.-Jan.	50,000
Natal	May-Oct.	150,000
Mozambique	May-Oct.	50,000
Total in Africa ...		582,000
Europe-Spain	Dec.- June	6,000
Total cane sugar crops ...		12,305,400

(II) Beet Sugar.

Europe.

	Harvesting periods.	1919-20 tons.
Germany	Sept.-Jan.	1,000,000
Czecho-Slovakia, etc. ...	Sept.-Jan.	775,000
France	Sept.-Jan.	165,000
Belgium	Sept.-Jan.	125,000
Holland	Sept.-Jan.	250,000
Russia (Ukraine, Poland, etc.)	Sept.-Jan.	350,000
Sweden	Sept.-Jan.	150,000
Denmark	Sept.-Jan.	160,000
Italy	Sept.-Jan.	150,000
Spain	Sept.-Jan.	120,000
Switzerland	Sept.-Jan.	4,000
Bulgaria	Sept.-Jan.	15,000
Total in Europe ...		3,264,000
United States-Beet ...	July-Jan.	800,000
Canada-Beet	Oct.-Dec.	20,000
Total beet sugar crops ...		4,084,000
GRAND TOTAL—Cane and Beet Sugar		16,389,400
Estimated decrease in the world's production		29,000

[1] This means a drop of 134,000 tons from the previous year's figure.

[2] There has been an earthquake which may affect this figure.

[3] This has been actually produced in the season May to November of 1919.

The figures as given above show a decrease in the world's production this year over last of 29,000 tons but this is allowing for 463,000 tons increase of jaggery in British India which does not count; the total supply of the world in 1920 will therefore be some 492,000 tons less than in 1919.

The *American Sugar Bulletin* in its issue dated 14th November, 1919, considered the

first estimate[1] of the 1919-20 sugar crop of the world as published by Messrs. Willett and Gray as conservative and in the light of all the attendant circumstances suggested that the following increases should be made in their figures.

"The Russian crop is shown in the Journal's table as 350,000 tons, which is a decrease of 350,000 tons, compared with last year. This decrease, however, should not be regarded as important, because the demoralized financial and transportation conditions in Russia practically isolate her. Until such time as she again becomes either an importer or exporter, it confuses the world statistics to include her, although it is fair to say that any table of world production should show Russia's estimated yield. Omitting Russia from the calculations is like adding 350,000 tons to the available supply.

"Then the Java crop is harvested between May and November, and this year (1919) was 1,300,000 tons but is shown for 1919-20 whereas the 1920-21 crop will be 1,600,000 tons, and is so shown in the remarks. It is apparent that the 1919 Java crop has been most potential in making a scarcity of sugar in Europe this fall by 400,000 tons (as the previous crop was 1,700,000) and that the 1920 crop will be able to supply to this extent the consumption of the autumn of 1920. But statistically, by crediting the 1,300,000 crop to the 1918-19 crop, and 1,600,000 to the 1919-20 crop, it would seem to increase the world's supply for 1919-20 as compared with 1918-19 by 700,000 tons.

"The journal's estimate for Cuba is 4,300,000 long tons while the consensus of opinion among sugar men is that 4,500,000 may be looked for.

"Based on these facts, we find the following increases over those shown in the Journal's table might by some authorities be considered sound.

	Tons.	
Russia,	35,0000	(account commercial isolation)
Java,	700,000	(new crop instead of old.)
Cuba,	200,000	(consensus of trade opinion)

"In addition to this, the Journal says the consumption of the United Kingdom is indicated at 1,200,000 long tons. This information is, of course, not reflected in the Journal's table of world production but we think it proper to call attention to the fact that any marked decrease in consumption is equivalent to an increase in world available supply. We understand the British estimate is 1,160,000 tons."

We accordingly come to the position that if we exclude British India's increased jaggery production of 463,000 tons in 1919-20 over that of 1918-19, which does not affect the world's sugar position, Messrs. Willett and Gray's estimates show a decrease in the world's supply of sugar to the extent of some 492,000 tons in 1920 as compared with the year 1919. On the contrary according to the *American Sugar Bulletin* even if we omit India's increase of 463,000 tons, the world's available supply of sugar in 1920 will be over eight hundred thousand tons more than in 1919.

It may, however, be mentioned that the position has considerably changed since the above criticism in the *American Sugar Bulletin* appeared and it may be safely said that the situation in 1920 will be no better but rather worse for the following reasons.

The increased cane sugar production is off-set by the decreased production of beet-sugar in Europe to the tune of some 600,000 tons. Russia which consumed over one million tons before the war cannot go on with only 350,000 tons and it is even doubtful whether this figure will be actually realized in practice. The decision ot the Allies to open trade relations will therefore make it easy for her to import the required sugar if she can pay

[1] The first published estimate of Messrs. Willett and Gray showed the 1919-20 sugar crop of the world as 279,436 tons better than in 1918-19 and the criticism in the *American Sugar Bulletin* is based on that estimate. It may, however, be added that the later estimate showed deficit of 29,000 tons over the figures of *1918-19*. *It is the* revised estimate that has been given above in this article.

P.S.—Since the above was written, it has come to the knowledge of the writer that Messrs. Willett and Gray's latest estimates give the decrease in the world's production for 1920 as 516,339 tons. Excluding British India's increased jaggery production this comes to practically a deficit of a million tons of sugar this year as compared with last year.

for it and as she has surplus wheat, flax, etc., to barter I anticipate no difficulty in her getting sugar from abroad.

It is now pretty certain that Java's production of sugar during *1920* will be 1,562,000 tons, *i.e.*, about thirty-eight thousand tons less than the estimated figure of 1,600,000 tons. The total output of sugar in Formosa will also be reduced by some 60,000 tons as the result of the destruction, by a tornado that swept over the island, of a portion of the growing crop due for harvest in November 1919—June 1920. In the Philippines the crop this year will be 90 per cent of the 1918-19 crop on account of unfavourable weather conditions.

In Cuba even though the cane crop is in an exceptionally fine condition it is possibly unlikely that the whole crop will be put through the mill owing to the prevailing scarcity of labour and it is estimated that the new Cuba crop will amount to 4,446,429 tons. In the United States a new estimate of the domestic beet sugar crop places it at 644,000 tons against the 800,000 previously estimated.

Further the fact that it has been decided in Great Britain, the United States of America and several European countries to continue the control on sugar during the present year points to the world having to face a serious shortage this year and I foresee very keen competition in the world' smarkets for Cuban and Java sugar.

VII. Conclusion.

The dominant facts in the world's sugar situation in 1919 were a shortage of nearly 2 million tons as compared with the output in 1914-15, increasing costs of production and increased rates of transport and it is already evident that the situation in 1920 is to be no better. With the war now over the European populations are increasing their consumption of sugar. The demand from the United States of America is also on the up grade and it is probable the consumption this year will well exceed 4 million tons while the total production available from the United States of America and its insular possessions will hardly exceed 2,100,000 tons. Consumption of sugar is also increasing in China and the Far East. In view of the high price of this commodity due to the shortage of supplies Governments in various countries are trying to regulate consumption. In England it was announced by the Ministry of Food that consumption in 1920 is to be reduced by half a million tons, *i.e.*, it will be limited to a little over one million tons. In France a proposal to make sugar a Government monopoly is under consideration. In various other European countries restrictions are being imposed not only to meet the existing shortage by limiting the use of sugar but also to prevent the balance of trade from going very much against those countries and aggravating still further the unfavourable exchange rate against their depreciated currencies.

To conclude :—European beet sugar production instead of showing any recovery from the effects of the war will this year be actually less than last year. The shortage of this beet sugar is being partially met by the increase in cane sugar production outside Europe but as the world's consumption of sugar is on the increase great efforts are required on the part of the cane sugar industry to meet the deficit of beet sugar and to supply the normally increasing demand. High prices are thus bound to prevail for sugar until cane sugar production increases to this extent or beet sugar comes into its own again: but the more carefully one examines the situation the more difficult it is to say when this will happen.

Thus a great future opens for all countries who are not faced with insuperable difficulties as regards increasing their output while those countries who spent money in the past in putting their sugar industry on a sound basis are now reaping an ample reward for their energy and foresight.

CO-OPERATIVE LAND MORTGAGE CREDIT FOR INDIA.

BY A. P. SMITH.

AN arresting paper on the subject of Co-operative Land Mortgage Credit for India is to be found in the *Agricultural Journal of India*, Vol. XV, Part 1. The author is Mr. H. R. Crosthwaite, C.I.E., Registrar of Co-operative Societies, Central Provinces and Berar, whose knowledge of the complicated problems of the Co-operative movement in this country is unsurpassed. Mr. Crosthwaite takes for his text the following dictum from the *Wealth of Nations*. "It is not by augmenting the capital of a country, but by rendering a greater part of that capital more active and productive than it would otherwise be so, that the most judicious operations of banking can increase the industry of the country"—a dictum which is undeniable. It is fairly evident to those interested in the co-operative movement in India that it has made, as Mr. Crosthwaite says, "phenomenal progress" since it was started: progress that is not to be minimised by instances of failure here and there due to a legitimate, or imprudent, endeavour to accelerate the pace of progression." This tendency to travel fast is condemned by critics, but the propensity indicates that there is enormous scope for the expansion of co-operation. Co-operation by no means alien to the people who are chiefly responsible, and not the officials directing agency, for the rapid expansion so characteristic of co-operation, notwithstanding some mistakes. Another reason for the phenomenal progress lies in the fact that, owing to sound organization it provides borrowers with credit on reasonable terms, and also offers a safe investment to lenders—a double obligation most serviceable to persons in need of small credit, which is easily supplied by persons possessing limited capital, thus putting into circulation money which but for the movement would lie unproductive by being hoarded. Mr. Crosthwaite is disposed to treat with scant courtesy critics who hold the opinion that the quality of the co-operative movement leaves something to be desired. He also questions the assertion of condemnatory critics that it is impossible to turn into a means of moral education, co-operative land mortgage, inasmuch as it is a sordid business, and which, for that very reason, should not be attempted. Before forming a definite opinion on the subject Mr. Crosthwaite invites consideration of the political economist to the following questions: (1) "Whether co-operative land mortgage can benefit India, (2) whether, and under what conditions, this particular form of co-operative effort is possible in India, and (3) whether the enormous sums of money which are required for organized land mortgage credit can be found in India." It is unnecessary to follow Mr. Crosthwaite in his lengthy discussion of these questions. The object of this paper is merely to draw attention to the facts recited by him in a publication not generally current among the general public and the conclusions which he draws in his paper which every student of co-operation should make himself acquainted with. Mr. Crosthwaite's experience and knowledge of India and its peculiar conditions, render him an efficient guide in discussing co-operative problems. The answer to the question: "Can co-operative land mortgage benefit India" is—"It undoubtedly can"; and success lies mainly in obtaining sufficient capital for the improvement of agriculture, especially intensive agriculture, for machinery for the adoption of modern methods, the adequate and sustained supply of labour, and a well maintained increase in the country's food supply. Intensive development of agriculture must proceed *pari passu* with industrial expansion, if food prices and wages are to be such as not to prejudice the sale

of the products of Indian industry. Prices will be limited under the influence of trade competition. Agricultural credit therefore is a subject which demands and deserves the closest attention as being the basis of India's future prosperity. Now for the second question—whether and under what conditions, 'this particular form of co-operative effort is possible in India." In answering this question also it is necessary for the student of co-operation to peruse Mr. Crosthwaite's article. He thus sums up the merits attaching to a mortgage credit association as an agency for providing the land-owner with long term credit, as follows:—

"They enable land-owners to mobilise the wealth represented by their landed possessions by the creation of bonds passing into the general system of securities. These bonds are not, like an ordinary mortgage security, of any restricted currency, but are realizable at any time in the open market. (2) The loans granted are not subject to recall. (3) The rate of interest is as moderate as possible—far more moderate than a borrower could secure if single handed, and he is regulated by the market rate. (4) The rate of interest cannot be raised. (5) The right is conceded to reduce the debt by payments made at the mortgager's convenience. (6) The necessary elimination of the capital debt is accomplished gradually. (7) The costs of valuation and other charges are low. (8) The administration is at once relatively inexpensive and the office holders highly qualified for their work."

The difficulty of organizing and setting at work societies and banks to do all that has been summarized in the foregoing quotation is not lost sight of. But difficulties are meant to be surmounted and it will possibly be necessary for the State to appoint special officers to organize and assist this side of co-operative action. The third question for which an answer is to be found is: "Whether the enormous sums of money which organized land mortgage credit requires can be found in India? "Mr. Crosthwaite expresses the opinion that the question is an administrative one and reasonable and prudent expenditure by the State on practical education—the right kind of education by competent persons—would form the premium for an endowment insurance which will mature and, in the end, more than recoup the State. Attention towards achieving success, is drawn to the large sums of money which lie unutilized for months in the Government treasuries, to the absorption of vast quantities of gold and silver by the people, and to the fact that Indian exports are much larger in volume than Indian imports. Again, as it is the essential function of co-operative mortgage credit banks to convert funds, which are locked up and are immobile into a form of security which is readily negotiable by being split up into bonds of small denomination, in the possession if numerous holders, landed securities may be converted into a form of exchange like currency notes, backed as they are by reserves of real estate instead of a inelastic reserve. For these reasons, among others, Mr. Crosthwaite is of opinion that there will be no lack of money, for, inasmuch as a system of organized land mortgage is gradually developed, production and consumption will increase and industries and trade will flourish.

With the adoption of such means Mr. Crosthwaite believes in the success of co-operative credit in the various provinces and, in view of the fact that co-operation is not alien to the Indian people, the future of co-operation would be assured provided Government lend their unstinted support, in all possible ways, towards stabilizing credit, providing funds by establishing suitable banks and affording means of practical education to that end. Industrial expansion is as yet an unsatisfied aspiration and agriculture is the mainstay of the people and the Government and it goes without saying that the co-operative movement intelligently engineered and sympathetically dealt with, will go far to release the ryot from the incubus of the money-lender, will facilitate intensive cultivation on modern lines and provide adequate food for India's millions while the slow development of Indian industrial life is being accomplished.

THE TEACHING OF INDIAN ECONOMICS.

By B. G. Bhatnagar, M.A.,

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WHEN in July last I adopted my new career as a teacher of Economics, I had three definite problems before me and all of them referred to the teaching of Economics in its various branches. By far the most important problem before me was How to teach Indian Economy. Had there been one common method of teaching the subject prevailing in various colleges in these provinces, the problem would have never attracted my attention, but as it is the variety of ways in which it is being taught in the colleges, and at the University, and the great divergence of opinions prevailing here and there as to the best method of teaching it spurred on my imagination to select for myself a method of teaching at once simple and intelligible.

As a student I had gone through two different methods. In a mofussil college, where I read for my B.A., they used to teach it as an independent subject, in the second year of the course, when they had done with the Principles of Economics and this I believe is fairly representative practice of other affiliated colleges in these provinces. The idea is further supported by the clear line of demarcation drawn in the University papers, although in the question papers of the recent years, this tendency seems to be slowly fading away. The method adopted to teach it used to be to dictate notes beginning with the broad physical features of India, in their barest outlines, and without expressing any relations of cause and effect or the complimentary nature of the various regions. Then would follow a mere enumeration of the various agricultural and mineral products, the kinds of cattle found in India, the names of systems of canals and railways, the number of factories of various kinds, the out-put of coal and iron in India and the desirability of protective tariff. So did end Indian Economy in a mere enumeration, a dull and un-interesting reading, though certainly very emenable to the methods of rote. While here in the University I learnt the basic facts about Indian Economy from a map, and realised the full significance of a Geographic treatment of Indian Economy. The necessity of the study of Indian Geography seems to have been understood by the various teachers in these provinces, as a reference to Indian Geographic phenomena is met with in the notes given by most of them. But still they do not seem to have fully realised the intimate connection between the Geography of India and Indian Economy and still less the importance of treating the subject in a Geographic way. The failure to recognise this important fact seems to have been due to the general misconception of the term Indian Economy, and the undeveloped character of the science of Geography itself.

Students of Economics in India have been labouring up to very recent times under the un-realised and un-realisable hope that at some time or other we shall have developed some general principles or laws peculiar to this country. They thought that the books written by western economists were not applicable to India at all, and that if we wanted to make some real progress in economic thought about India we must discover and develop those peculiar unities which underlie the economic activity of the people of this land. This was the view of that school of economists to which such prominent men as Ranade, Gokhale and many others belonged. But the modern day student of economics in India has begun to realise that the fundamental laws of the science of Economics are quite as applicable to India as to other western countries,

although they need a little modification here and there. In consonance with this changed outlook towards the science of Economics, a change has come to pass in the meaning of the term Indian Economy. If to the old school of economists Indian Economy stood for a collection of laws of consumption, production, exchange, and distribution, peculiar to this country, then to a present day student of economics the term signifies a mass of information statistical and descriptive pertaining to Indian *economic conditions and* problems and any proposed solution thereof. Thus V. G. Kale one of the leading living Indian economists observes "Indian Economy is not a separate science, because it does not seek to discover new laws. We have indeed to observe things as they are, and describe the economic activities of the various classes of the population, and the different economic phenomena like high prices, low wages and increasing rents, and to point out the relation of cause and effect. But we have also to point out how improvement may be effected by individual or collective action, and how evils may be prevented and remedied. It partakes more of the nature of the art of economics or of a normalive science."

Now if we concede that this is the correct way of looking at Indian Economy, and if we at the same time recall to ourselves the modern idea about Geography, then we would be able to realise the importance of Indian Geography in the teaching of Indian Economy. Modern Geography is more than a catalogue of facts, it is also a study of the relationship of these facts. The old idea of Geography was of teaching what and where, the modern Geography also answers why. The relation of cause and effect is also recognised now in Geography. A modern student of Geography also traces the results or influences on economic, social and other activities of the people living in a geographic unit. Modern geography lays great stress upon the human side of geography, and seeks to explain the relations of human life to earth, *i.e.*, it now asks what is the significance of the various geographic data such as rivers and mountains to man or we may say it attempts to answer how the various geographic features of a certain country have influenced the activity of the people there. Modern Geography then is the study of the earth and man as related to each other, and not a description of the features of earth alone. It studies the features of the earth so that the people may be understood, and the future possibilities of utilisation of environments to increase the well-being of men may be discovered.

From the above discussion of the nature of the two subjects, it would have been made clear that two branches of Indian Economy lend themselves pre-eminently to geographic treatment. One where it seeks to describe the various Indian Economic phenomena, such as the distribution of population, the distribution of crops, the existing development of industries and the varied habits and efficiency of the people. And two where it seeks to propose solutions of certain economic problems in India such as the economic distribution of crops after the introduction of the means of communication, the possibilities of the development of certain industries in certain parts of the country, the possibilities of developing hydro-electric works and the laying out of the means of communications. All of these can be taught by the method of notes and rote as they are being done now in most of the colleges, but it is an unreal, lifeless and impractical method wherein it is difficult for the student to remember things for any considerable time and wherein it is thoroughly impossible for him to make any practical use of his learning in after life. All these things should be taught with reference to a map, pointing out cross references of environments in the delineation of present facts, and the explanation of proposed changes. To illustrate myself. Suppose we want to teach the

distribution of crops, then it is not enough to give an inventory of the various crops, raised in India in different parts and different seasons, but the reasons why they are grown in particular season, and a particular place should also be explained, and that can best be done by means of a map, where one can touch at the nature of the soil, the character of the rainfall, and the influence of the means of communication, all at a time, and point out that such a crop is the resultant of such and such natural environments, and that given those environments one should expect that crop to be predominent there. Then again while dealing with the distribution of population we should point out the determinant influence of the soil, the climate, the rainfall, the means of communication, and other industrial phenomena that are important in this connection, and this is best done by the help of a map where all these things are present in a common perspective. The student can see all things at a glance and realise their influence on the central point in a single view.

By adopting this geographic treatment of this subject, the student learns not only what he is expected to learn from notes, but something more, and in a shorter time and with a greater surety of longer retention than in the previous method. He learns to argue out for himself the relations of cause and effect, and is helped a great deal in cultivating broad and logical outlook, a thing very much to be desired, in our students.

But there is a still greater importance of the geographic treatment of Indian Economy in its other sphere, where it seeks to find out possibilities of economic development in India, and where it proposes to put forward definite proposals for attaining to definite ends. It is almost impossible to deny that industrial development primarily, though not exclusively, depends on matters described in geography-the natural products of a country, the character and efficiency of the people and the means of communication, which afford facilities for trade and determine the extent of the markets. If we grant as I believe we should that destinies of men are very largely determined by their environments, then the importance of the study of environments, will not be difficult to realise. Although human effort modifies the environments to a certain extent, yet the modifications achieved so far have not been very startling, and there is no hope of man's getting away completely from his 'surroundings.' The beginnings of economic activity, have always been determined by surroundings, and it is only in advanced stages of economic development, that man succeeds to a limited extent, in modifying his environments to suit his needs. Men's power over nature being limited, it is desirable from economic point of view to adapt his activity to his surroundings, to utilize natural forces to their best advantage and hence the importance of a close study of natural environments before we start on any industrial venture. If we go through the history of various unsuccessful enterprizes in India, we would come to know that 90 per cent of them failed because of ill-judged location, a mistake which an entrepreneur having gone through this sort of study will certainly not make.

From what I have said above it would have been made clear that the geographic treatment of Indian Economy is a thing very much to be desired and I hope that members of this Conference will see their way to adopt it. By this method a student not only is likely to learn things easily and quickly as I have said above, but this method helps him very much in acquiring a habit of picking up information about things from his environments for himself. "The cultivation of the map habit of thought is no less pregnant in the sphere of economics than it is in the sphere of stretagy."

A COMMITTEE ON CO-OPERATION FOR MYSORE.*

BY RAJASABHABHUSHANA RAO BAHADUR M. SHAMA RAO, M.A.,

Inspector-General of Education in Mysore (Retd.)

I thank the Government of His Highness the Maharaja for nominating me as a member of the Legislative Council as thereby I have gained an opportunity of bringing forward this resolution on the appointment of a Co-operative Investigation Committee for the benevolent consideration of the members of this council. There was a time when it was with very great reluctance that I took up the post of the Registrar of Co-operative Societies when it was first instituted by Government in the year 1905. The scheme of Agricultural Banks which were really co-operative societies under another name and which had been generously instituted by His Highness the late Maharaja Sri Chamarajendra Wadiar of revered memory had not, for one cause or another, fulfilled the expectations of success formed of the scheme and the Co-operative Regulation passed in 1905 was expected to share the same fate. Fortunately in His Highness the present Maharaja we had a born co-operator, one who realized the beneficient potentialities of co-operation long before any results could manifest themselves and but for whose ever watchful care, personal support, and financial help the development of co-operation would not have been what it has now attained to.

Sir, as years have gone on, I have come to believe that among all the beneficient measures initiated in India after the advent of British rule, the future historian of India will give a very high place to the co-operative movement. Ever since its inauguration in British India, the Supreme Government and the local governments have manifested extreme solicitude in its spread with the result that at the close of the year 1918-19, there were altogether 30,000 societies working in different parts of the country with a membership of 13,000,000, and a working capital of a little over Rs. 15,00,00,000. The loans granted amounted to the extent of Rs. 6½ crores and the profits made to 46½ lakhs of rupees, and the reserve fund amounted to nearly a crore and a half of rupees. These huge totals are, as Mr. R. Ranga Rao, our present Registrar of Co-operative Societies, has remarked in the last number of the *Mysore Blue Book Journal* somewhat difficult to comprehend, and the progress made can be more easily understood if I give the averages that Mr. Ranga Rao has given. For the whole of India, there was at the close of 1918-19 one society for every 8,022 of the population. It had a membership of 46, a share capital of Rs. 875, and a working capital of 5,120. It gave loans to the extent of Rs 2,411 and made a profit of Rs. 164. The reserve fund accumulated by it amounted to Rs. 449. In our own State, the average population per society was 4,709 and the average membership per society 68, with a working capital of Rs. 5,757 per society and a reserve fund of Rs. 360. The average loans per society amounted to Rs. 4,400 and the average profits to Rs. 274.

So far, we may congratulate ourselves that Mysore has held a prominent place among the different provinces and states of India and that a scrutiny of the figures relating to the annual rate of progress indicates that there is no relaxation of effort to make co-operation as successful in Mysore as in British India, if not more. If any proof is needed to show how useful the Co-operative movement is, and once successfully planted, how strongly it can take root, I have only to mention that in Russia, with all the horrors

*A speech delivered before the Mysore Legislative Council.

of the recent great war and with all its unsettlement, the co-operative movement was able to establish a University of its own in that country. I may also cite that the Supreme Council of allies announced a few days ago that while willing to raise the blockade of Russia, they could consent to trade being opened with that country only through co-operative societies. In short, it appears to me that the sphere of co-operation is as wide as the sphere of economic life itself and the more widely it is spread, the larger will its benefits grow in ever-widening circles. I may also refer, though this occasion may be considered not a fit one for the purpose, to the incentive it is sure to give to the public life of the country. Our president referred in his opening speech to a feature of the district elections for membership to this Conncil. The figures published show, as he remarked, in the official Gazette, that out of a total of 21,953 voters, only 5,694 came forward to vote, a number slightly over a fourth of the total number of voters, while almost three-fourths could not be induced to go to the place of polling. This unfortunate indifference may be largely attributed in Mysore as in British India to the extinction of the old communal village life. But there is every hope that with the experience gained of the working of co-operative societies, there will be a revival of the old communal spirit both in rural as well as in urban areas and that co-operation will be a powerful ally in the future in making the new Reform Scheme a success in British India.

Already Lord Willingdon and the Legislative Council in Madras, seem to have realized this aspect also of the co-operative movement and have allowed a provision of two lakhs of rupees in the Budget for the next official year and within the next two years a very large number of societies, about 4,500, especially Agricultural and Industrial, for which the Registrar has a scheme ready, are to be established. A sum of 4¾ lakhs of rupees has also been provided for loans to Co-operative Societies for house building in Madras. I am sure that we in Mysore will not like to fall behind our neighbours and be ungrateful to the memory of Sri Chamarajendra Wodiar, in whose time, long before co-operation as a means of affording relief to the rural agriculturists, was thought of in British India, the scheme of Agricultural Banks, which, as I said, are only co-operative societies under a different name, was instituted. It is supremely necessary, therefore, for us to strengthen the hands of the Registrar and of his co-adjutors and enable them to take a forward stride along with their brethren in British India.

The world-shortage of food supplies, of the raw materials and of appliances of industry and the appreciation of currency have made the problem of normal economic life very acute for almost all classes of people and it has become incumbent that any solution which holds out a prospect of affording relief even to a small extent should be readily grasped. The high prices of food grains are considered to largely benefit the cultivators of lands, but it must be conceded that to the extent they are purchasers of articles other than food grains, this benefit is discounted by their having to pay higher prices than before in common with others. Further, the position of the rural borrowers when they happen to have contracted to pay interest in the shape of grain instead of in money, is really to be deplored. I am not one of those that subscribe to the belief that money-lenders are all blood-suckers ready to pounce upon their victims and suck their blood to the last drop. On the other hand it may be accepted that in a very large number of cases they show consideration to the borrowers, though forced at times to make up for their losses by demanding higher rates of interest than they could have done if all their advances readily came back to them according to the terms of their bonds. Still, it must be said that the lot of a borrower from professional money-lenders is not usually an enviable

one and in these days though the prices of grains are abnormally high, it cannot be said that the rural borrower who has contracted to pay interest in the shape of grain has all the benefit of the ruling high prices to himself. I need not say that the rates of interest payable in money have also increased and attempts at commutation of grain-rates to money rates are not likely to much benefit the rural borrowers. Taking the Statistics of the Registration Department, I find that the number of mortgage deeds in the year 1918-19 was even higher than in the preceding year, 53,463 against 51,461 valued at Rs. 1,36,00,000 and Rs. 1,34,00,000 respectively. It is doubtful, therefore, whether the additional rupees that the high prices are supposed to have given to the agriculturist have really gone towards the reduction of his debt. To add to the difficulties of rural agricultural economy, there is constant sub-division of lands, thereby cousing much wastage of labour and weakening the incentives to efficient cultivation. No doubt the Government have laid down certain minima of extent for these sub-divisions but it is within the knowledge of all that the Shanbhog still continues to be in the confidence of the ryots of his village and that through his help many unrecognized and unrecorded divisions take place almost every day. Dr. Coleman, the Director of Agriculture, has already spoken strongly on the disadvantages resulting from too frequent fragmentation of cultivable lands and I believe that an efficient co-operative society in a village will be able to greatly minimise the evils of a system of equal partition of agricultural lands, by inducing combination among contiguous land-holders and thereby enabling them to adopt better methods of cultivation and to raise larger and better paying crops. We have next a very large number of artizans and smaller handicraftsmen who are being driven more and more to become agricultural labourers on account of outside competition and there is also the large class of small traders. In these classes, co-operation may be said to be still almost incipient and yet its advantages to them cannot be exaggerated. We have also to consider the interests of a few other classes who own no lands and whose incomes are derived either from their professions or from the appointments they hold in Government or other offices. The life of these people, especially of the middle class people who are forced to live in towns like Bangalore and Mysore with inelastic incomes has become very hard and in their case also relief is necessary. The Punjab Government has already given an increase of 20 per cent to the salaries of all non-gazetted officers and in Madras a committee is sitting to revise the salaries of officials. Whatever relief may be given in the shape of increase to salaries, with the growing cost of the necessaries of life and with ever-growing house-rent, the benefits of such relief cannot be lasting; and a Government which inasmuch as its revenues are fixed in rupees, suffers equally with the people by the depreciation of the currency cannot be expected to show ready practical sympathy every time there is a complaint of hardship from rising prices or crowded house-accommodation.

How far co-operation can be helpful to solve these problems of life it appears therefore necessary to investigate carefully and broadly. It is true that we have the reports of certain investigations made in British India and that we can benefit by them. Sir, I quite agree that to a certain extent, these reports are valuable to us inasmuch as they afford general directions for our guidance. I cannot, however, accept them as affording all the information that we want and as obviating the necessity of all local investigations. For instance, we have the report of the Merclagan Committee on Co-operation which may be said to be a monumental work, useful for the guidance of all co-operators. This report is, however, based on investigations made in British India and

on information supplied by the witnesses examined with reference to the conditions prevailing in their own parts of the country. Some members of the Maclaughlin Committee paid a visit to Bangalore also but it was a hasty visit and my friend, Mr. M. A. Narayana Iyengar who was the Registrar of Co-operative Societies at the time and whose unwearied zeal greatly popularized the movement will bear me out when I say that a cursory talk for an hour or two with a few of the prominent co-operators of Bangalore at a meeting arranged in the Registrar's office was all that took place and that none of those assembled at the meeting ever took the meeting with any degree of seriousness.

Yet the investigation of these problems is, as I have said, urgent and pressing and hence it is that I have taken the liberty of proposing to this council the desirability of recommending to Government the appointment of a Committee of investigation. This investigation should, in my opinion, apply equally to the human material needed for the efficient organization and supervision of the co-operative movement as to the condition needed for the successful development of industrial, agricultural and other forms of co-operation, to the reduction of the pressure of indebtedness on agricultural lands, the establishment of societies for small traders and artizans, for supari-garden owners in the malnad, and for cocoanut growers in Tiptur and other parts, to the supply of dairy and other products, to the establishment of Co-operative stores for the benefit of the consumers, to the forms of co-operative societies best suited for the malnad ryots, to the problems of housing so as to relieve overcrowding in the existing houses and so as to arrest future insanitation in the new houses which may come into existence. In fact, there are no spheres of life, as I have already said, where co-operation cannot be used as a powerful instrument for the uplift of the people living in such spheres but at the same time it must be acknowledged that the problems confronting those who work in the co-operative field are some of the most difficult problems that their brains can tackle and behoves us to provide readily to their hand every kind of assistance that can possibly be devised. Mr. Chandy, the present Revenue Commissioner, will, I am sure, confirm my statement as to the difficulty of several of the co-operative problems for, during the short period that he was Registrar, he signalized his office by starting an investigation as to actual relief that the co-operative societies working till then, had afforded to their members. I do not know whether this investigation is being continued or how far it has reached. There can be no denial, however, as to the usefulness of the inquiry instituted by Mr. Chandy. The inquiry indicated that while the amount of the indebtedness of the persons examined remained practically the same, the conditions attaching to that indebtedness altered materially for the better. Out of the 20 lakhs and odd due to money-lenders, nearly half, it was found, had been paid up and that in place of the high rates of interest and of the onerous conditions under which advances had been made, reasonable rates of interest and easy conditions of repayment were found substituted. It was also found that the borrowers after they became members of co-operative societies had ready means of carrying on their agricultural operations and that they had actually increased their assets from 91 lakhs to 107 lakhs. It should be remembered, however, that this investigation related to only 180 out of the total of 1,097 societies and to 8,200 members out of a total of 81,168 members. It will be no surprise to me if the present Registrar has fought shy of continuing an investigation which involves stupendous labours and which needs a very efficient, well trained and adequate staff of officers to arrive at fairly correct results. Mr. Chandy's investigation, however, goes to illustrate the truth of the Kannada proverb that while we have butter on hand, we are wandering to fined ghee. If only the rate of interest could be covered by even a single per cent, if only we could increase the yield by a single seer per gunta of land there will be a large accession to the rural wealth of the country and money can be easily found for not only education but also for other improvements.

If the Governmentare pleased to accept the recommendation now made for the appointment of a committee, the committee should be able to visit all the important centres in the State, examine witnesses,

see how far the existing co-operative societies fulfil the functions assigned to them, and what impediments stand in the way of a larger and more rapid development of these societies. The annual conferences of co-operators arranged by the Registrar both at district head-quarters and during the Dasara at the capital have already afforded some indication of the lines on which investigation should proceed. But pressed for time as such conferences are, their deliberations and conclusions lack authoritativeness and can at best be taken only as mere data for further investigation. A deliberative body of persons, possessing expert knowledge and adequate training, who can approach their subjects with fresh minds and without any preoccupations will, we may feel certain, be able to conduct their investigations in a thorough manner and produce a report the value of which cannot be gainsaid both as a record of reference as well as for inspiration for the wider spread of this movement in particular parts of the country or in particular spheres of activity. At present, for want of such a report dealing with the actual conditions of the Mysore State and embodying suggestions as to the lines on which societies started should be conducted, it has been found that many persons who are really in earnest to associate themselves with the Co-operative movement are forced to hold back on account of their inability to obtain a clear vision as to their procedure when they enter the co-operative field. I may also say that the appointment of a committee, the visits of the members to the several parts of the State, their examination of witnesses and the open manner of their investigations, will go a very great way in arousing public interest and arresting public attention which in themselves will serve as great incentives to the more rapid growth of the co-operative movement.

With these words, Sir, I beg to commend my resolution for the kindly acceptance of the members of this council and conclude with the hope that each one of us, though it may be only like the humble squirrels which are popularly said to have each contributed a few grains of sand for the building of the great bridge over the ocean that Rama is said to have built to cross to the island of Lanka, will contribute his share of support to build up the co-operative structure which His Highness the Maharaja has so anxiously started for the benefit of his subjects.

BANKS IN INDIA.

BY THE EDITOR.

MR. Findlay Shirras' statistical tables relating to Banks in India for 1918, just issued is a document of some interest. We do not propose to review at length here the introductory memorandum which is prefixed to the tables, interesting as it is, but only desire to draw prominent attention to certain points brought out by a careful study of the tables. The map issued with this statistical survey deserves more than a passing mention. In it, those interested in the utility of Banks will find considerable food for study. The distribution of almost every description of Banking in India is shown in it. It is a thoroughly graphic representation of the distribution of all existing Banks in India, and their branches and agencies. One thing that the reader is struck with is the large space still left blank in the map of India, from the banking of India. When we turn to the tables, we see how true this impression is. The number of towns in India in which banks and their branches are situated is 176, or 25 per cent of the total number of towns in India having each a population of 10,000 and over, according to the Census of 1911. There are 75 towns with a population of 50,000 and over. In 59, or 79 per cent of these towns there are banks. In the remaining 16 towns there are banking facilities. There are altogether 96 head offices and 322 branches. The Presidency Banks of Bengal, Bombay and Madras have, besides their head offices, 68 branches and agencies. The Exchange Banks working in India have 48 branches and agencies and the Indian Joint-stock Banks (including the Bank of Mysore, Bangalore) have 93 head offices and 206 branches and agencies. The last of these may be dealt with a little further here. These are, speaking generally

scattered chiefly throughout the North-west of India, especially in the Punjab and the United Provinces. The tables included in this volume deal with only those banks (47 with 197 branches) which have a minimum paid-up capital and reserve of one lakh of rupees. These banks are sub-divided into two classes, namely, (i) those with a paid-up capital and reserve of 5 lakhs and over, and (ii) the more or less pigmy banks with a paid-up capital and reserve between one lakh and less than Rs. 5 lakhs. The aggregate paid-up capital and reserves of these 47 banks in 1918 amounted to Rs. 6,65 lakhs, the deposits to Rs. 42,15 lakhs and the cash balances, to 985 lakhs. That shows the lee-way that has still to be made up, if Banking is to achieve in India what it has in every part of the civilized world. The patriotism of a banking has still to be created in India, but that can only come into existence when the facilities for bank are bettered in this country. This remark holds good despite the fact that there are the Post office, Co-operative and in our own State, the State Savings Banks. According to the tables published in the volume, the first two of these did good work in 1918. The Post office Savings Banks had over a million and a half depositors and about Rs. 19 crores or over £ 12 millions sterling on deposit. The capital and reserves of the Co-operative Credit Banks, registered under the Co-operative Societies Act amounted in 1917-18 to Rs. 3¼ crores and the deposits (including loans held by the Banks) to Rs. 11 crores. According to a statement (Appendix I) appearing in this volume the Bank of Mysore, besides its head office at Bangalore, had, in 1917-18, branches or agencies at Channapatna, Chikmagalore, Davangere, Mysore, Shimoga and Tiptur. Its progress during the past five years is thus set down in table 17 :—

(Figures in thousands)

Year	Paid-up Capital	Reserve and Past	Total	Deposits					Cash Balance
				Fixed	Savings Bank	Current	Other	Total	
1914 ...	9,90	...	9,90	...	...	...	...	15,68	10,60
1915 ...	10,00	50	10,50	19,10	63	8,27	...	28,00	17,92
1916 ...	10,00	2,01	12,01	28,42	1,05	10,91	51	40,89	12,87
1917 ...	10,00	2,51	12,51	43,39	93	16,62	...	60,94	15,00
1918 ...	10,00	3,50	13,50	45,13	1,16	25,67	11,60	82,96	24,51

That shows steady progress no doubt but that a great deal more requires to be done to popularize sound banking in the State cannot be gainsaid. Now that the Presidency Banks are adding to their strength by amalgamating, it is necessary that the Chief local Bank run on Joint-stock lines should be enabled to augment its paid-up capital and its reserves and rest, in order that it may attract more deposits and open further branches and agencies, in order that trade and commerce may be given the aid that they deserve.

A NOTE ON THE DEPRESSED CLASSES OF MADRAS PRESIDENCY.*

By G. F. Paddison, M.A., I.C.S.,

Commissioner of Labour, Madras.

The depressed classes have been divided by the Government of India into—

(*a*) Aboriginal and hill tribes,
(*b*) Criminal tribes,
(*c*) Untouchables.

The first difficulty that presents itself in discussing the past and still more in considering what has to be done in future in regard to these classes is that it is by no means easy to discover exactly what tribes and castes should be placed under each or any of these categories. The Dombs for example show distiuct criminal tendencies, are outcaste and it is doubtful whether they should not be classed as a hill tribe if not as aboriginal. They are not however included at all in the lists compiled in G. O. No. 1676, dated 2nd December, 1919, from the reports of Collectors, whereas the Pano who is probably simply a Domb under another name is concluded as a hill tribe but not as an untouchable. The Paidis who are Dombs under Telugu names, are not included at all. The Yerukalas and Yanadis whose claims to be considered aborigines are very doubtful and the Malayalis who are admittedly somewhat recent emigrants from the plains are included as hill tribes, whereas such well-known aborigines as the Gadabas, the Gonds or the Konda Doras are hot included at all. The Poraja is shown as a hill tribe, but it is more than doubtful whether this is a separate tribe and its members should not be classed under Gadabas, Khonds, etc. The Irulas are included under hill tribes in Coimbatore and North Arcot. The total population of the Irulas for the Presidency is over 100,000, but of these, only 2,300 are shown in the last census as speaking the Irula language, and only 5,400 are entered as animists. The Irulas of Chingleput are far more civilized than the forest dwellers of the Nilgiris. Mr. Thurston found great difference in the characteristics, even physical characteristics of the domesticated Irula and his jungle relations. So with the Kurumbas. Out of 144,000 only 3,000 speak the Kurumba language, and only 700 are shown as animists. Perhaps the most startling instance is that of the Reddis or Kapus, the largest caste in the presidency—"the great landholding body of the Telugu districts who are held in much respect as substantial steady going yeomen and next to the Brahmans as the leaders of Hindu society." Yet of these no less than 6,400 are shown as animists in the census report of 1911. Probably these should be included under the Konda Doras of Vizagapatam who are sometimes known as Konda Kapus. Some of them may be accounted for by the Konda Reddis of Godavari Agency who are said to be allied to the Koyas. The matter is not merely of abstract importance, as certain privileges are attached already to the backward classes or castes and to the panchamas by the education and co-operative departments and these privileges may be extended. Untouchability would, it would seem, be easy enough to check. But a real difficulty occurs in the case of the Indian Christian who by his conversion to Christianity has lost his claim to be a Panchama. It is certainly hard that he should have to pay more for his privilege because he has changed his religion, or only be granted such privileges on claiming to be an out-caste from a religion which has ceased to be his own.

The following tables show as far as it has been possible to collect them,

I. first, the aboriginals and hill tribes

*Note issued by the Government of Madras, (Rev. Dept.) on 8th March, 1920.

in the presidency whose claim to the title is undoubted;

II. secondly, those tribes or castes of which some may undoubtedly be included but perhaps not all;

III. thirdly, those whose claim to be included at all is uncertain.

TABLE I.

Names of tribes	District	Population.
Khonds	Ganjam and Vizagapatam	3,54,940
Savaras	Do	1,86,128
Porojas	Vizagapatam	92,737
Jatapus	Do	92,520
Konda Doras	Do	89,775
Koyas	Vizagapatam and Godavari	79,422
Gadabas	Vizagapatam	45,115
Badagas	Nilgiris	38,180
Paniyans	Nilgiris and Malabar	34,574
Gonds	*Ganjam and Vizagapatam*	25,596
Vettuvans	Malabar	20,196
Kurichiyans	Do	9,722
Chenchus	Kurnool	7,449
Palaiyars (or Puliyans)	Coimbatore and Madura	4,315
Malasars	Coimbatore	4,199
Karimbalans	Malabar	2,898
Mavilans	Do	2,517
Kattu Nayakans	Do	2,475
Sholagars (including Panirs) ...	Coimbatore	1,944
Paliyans	Madura, Ramnad and Tinnevelly ...	1,452
Mudugars or Muduvars	Coimbatore	1,210
Kotas	Nilgiris	1,163
Kanis (or Kanians)	Tinnevelly	1,074
Kadars (or Kadans)	Coimbatore	791
Todas	Nilgiris	748
Arunadans	Malabar	182
	Total ...	1,101,322

TABLE II.

Names of tribes	District	Populati
Kapus (or Reddis)	Vizagapatam and Godavari	2,678,9
	(Animists)	(6,3
Kurumbas	Coimbatore, Nilgiris and Malabar ...	1,44,0
Do (language)	....	(3,0
	Animists	(6
Irulars	North Arcot, Coimbatore and Nilgiris ...	1,00,6
Do (language)	....	(2,3
	(Animists)	(5,3
Bagatas	Vizagapatam	33,0
	(Animists)	6,4
Melakudis (or Kudiyans)	South Kanara (includes the Kudiyas in the plains)	4,12

TABLE III.

Yanadis	Guntur, Kistna, Nellore, Cuddapah and Telugu districts generally	1,21,54
Yerukalas	All over the Presidency	88,24
Panos	Ganjam and Vizagapatam	71,32
Dombos	Do	62,97
Malayalis	North Arcot, Salem and Trichinopoly ...	63,487
Lambadis (or Sugalis)	Guntur, Anantapur, Cuddapah and other Telugu districts	49,418
Paidis	Gunjam and Vizagapatam	48,610
	Total ...	5,04,604

Out of 1,101,322 in the first table over 1,000,000 come from Ganjam, Vizagapatam and Godavari agencies. This forms a continuous area of 20,000 square miles at an average height of about 2,000 feet in the eastern ghauts in the north of this Presidency adjoining the Central Provinces and Orissa. No less than nine different languages, Telugu, Oriya, Khond, Gadaba, Gondi, Konda, Koya, 'Poroja' and Savara, are spoken in tbis tract. The country is administered by the Collectors of the three districts, here styled Agents to the Governor, who have in addition large areas in the plains or ordinary tracts to supervise. There are three sub-divisional officers whose divisions are entirely in the agency tracts and others are only able to devote part of their time to the agency portion of their divisions. There is no doubt that one at least of the impediments to the development of these tracts has been the comparatively small time and consideration which the heads of the districts are able to spare for this important part of their labours. Moreover the tract is extremely malarial and infested with wild beasts and

most of the hillmen carry battle-axes with them which they are not afraid to use on provocation. It is not therefore surprising that service in these tracts is extremely unpopular with subordinate officials of the plains. The question of remedying this defect by reducing the size of charges and as far as possible making these charges self-contained is under the consideration of Government. This would of course involve a considerably increased expenditure which could not be met by any equivalent increase in Land Revenue as the greater part of the area is comprised in permanently settled zamindaris, and the area to the north of Ganjam which is directly under Government is chiefly occupied by the Khonds from whom no Land Revenue is now levied. On the other hand there is a possibility of discovering valuable minerals, there are great possibilities of hydraulic power, and the forests which ought to conserve the bead waters of the streams on which the plains rely for their irrigation might be saved from destruction. This is of the greatest importance, as the rivers are rapidly being silted up to an alarming extent and nothing but the personal influence of a man who is in continual contact with these wild tribes and thus gains their confidence can have effect in inducing them to refrain from the wanton destruction of the forests. How much can be done by the right man has been shown by Mr. Welchman among the Savaras of the Parlakimedi Hills, by Mr. Bennett and Mr. Minchin among the Khonds of Pondukhol and by Mr. Harris in Hill Madgole; over tbe the borders in Orissa, Mr. Ollendorf the Sub-divisional Officer (the area of whose charge is not a quarter of the areas under the Divisional Officers in Ganjam) has been able to induce the Khonds to forswear strong liquor, to grow potatoes on a large scale as a profitable crop (Mr. Vernon in Vizagapatam made a similar effort some years ago but was transferred before his experiments could take root), and has generally become looked up to among the Khonds as the father of the people. Special efforts have been made recently by the Madras Government to open up and to develop these agency tracts. A special Malaria Officer was appointed though his place had to be kept vacant during the war. Measures have been taken to make the head-quarters of the Vizagapatam Special Assistant Agent and other places in that agency more habitable by draining the malarial swamps. Large sums have been allotted in recent years for the creation and improvement of roads and bridges. The railway from Vizagapatam to Raipur will pass through the Agency Tracts and in Ganjam the projected district board line from Berhampur to Russellkonda will give an outlet for the agency products especially turmeric which is the hillman's most valuable asset. It is probable that hereafter where communications have been improved many parts of the hills may be covered with plantation products. Coffee and oranges have already been tried with success on a small scale in various parts of the agency.

But though the country generally may benefit by the opening up of this wild tract, there are dangers that the advance of civilization, unless preventive measures are taken, may lead to the deterioration and not to the progress of the hill-tribes. As communications are improved, the danger from malaria diminished, and the fear of the tribes is curtailed by administration, the money-lender, and the drink-seller and the litigant come in. The hill-men, though many of them, notably the Savaras and some of the Khonds, are excellent cultivators, are nearly all of them thriftless and too many of them addicted to strong drink especially during the month of Chaitra when it is the duty of the hillman to spend his days in hunting and his nights in debauchery. Drink leads to debt with the sowcar, who generally combines the profession of money-lender and publican, and debt leads to the loss of land, the hillman's only capital. When he has

lost his rich paddy land in the valley he is compelled to resort to 'podu' cultivation on the hill side, burning down the forests, cultivating for a year or two, and then moving on to another patch of jungles. In Hill Madgole to give but one instance, Yendrika Hill, which twenty years ago was clothed with splendid forest, the haunt of the bison and the sambhur, is now absolutely bare. In many cases the hillman after he has lost his land, loses also his personal freedom and is compelled to repay a hundred times over in service a loan of which he probably only obtained a mere fraction originally. Efforts have been made to put a stop to these malpractices by a special Act (Act I of 1917) in accordance with which no transfer of land from a hillman to an outsider will be recognized unless it is approved by a Government official of standing. The rate of interest has been limited and measures have been taken to prevent the Courts in the plains from dispossessing the hillman of his lands by a decree in his absence. In some parts of the Agency the lands of the outsiders are to be roughly surveyed and registered, so that hereafter no outsider can claim any other land without producing a Government official's approval of the transfer. Khond land in Chokkapad, Goomsur and the Mohiri hills was assessed at a specially light assessment in the resettlement on condition of non-alienation. Special loan rules to enable the hillman to take advances from Government on the joint security of the villagers and repay them, as he prefers to do, in kind, are being framed, and co-operative societies are being started to enable them to bank their savings and to obtain cheap loans and in two cases, to enable the hillman to dispose of his produce without being cheated. A Special Officer has been appointed to deal with co-operation in the Ganjam Agency. Among a people so honest (though at present so thriftless) as the hillmen co-operation if well supervised and if collections are made in kind at the right season should have a very bright future. Special rules have been made to regulate or to prohibit the reduction of these tribes by emigration agents playing upon their credulity. Efforts are also being made to restrict the drink evil by largely reducing the number of arrack shops, and thus removing temptation from the doors of the hillmen. As for education there is a larger number of schools under the management of the Government and local boards especially in the Godavari Agency. There were on 31st March 1919, to quote the latest Education report, 289 schools in the three agencies chiefly intended for hill tribes, attended by 9,813 pupils of whom 4,550 belonged to the aboriginal classes. The total number of aboriginal pupils in all classes of schools in the agencies was 6,127. Scholarships have also been awarded chiefly among the Koyas, Khonds, Savaras, Gadabas, Jatapus, and Porojas, to induce them to attend school. There are Government sessional schools for the Khonds and Savaras and some training has been given to hill tribes in a training class in the Bhadrachalam scondary school. A problem which still has to be tackled in connexion with these and most of the other hill tribes of the Presidency is that of venereal disease which is rendered virulent here and elsewhere by the promiscuous habits of the hillmen before marriage, though after marriage they are generally faithful.

Private effort in these agencies has been practically confined to Christian Missionary bodies. The Rev. J. Cain and Mrs. Cain of the Church Missionary Society bave for many years done admirable work among the Koyas, teaching them lace making and other industries, curing them in their sickness, and generally endeavouring to bring them to a civilized mode of life. The German Lutheran Mission worked for some years among the hill tribes of Vizagapatam, chiefly among the Dombs. And the American Baptist Mission in the Ganjam hills has established schools largely attended by the Panos and

by some of the Khonds; in addition to literary education some of the Pano children are being trained in weaving.

The next most imortant area is *The Nilgiris* where the chief tribes are the Badagas, the Kotas, and the Todas who are found almost entirely on these hills, and the Irulars, Paniyans and Kurumbas most of whom live outside the district. The Badagas have a doubtful claim to be classed as an aboriginal or hill tribe, as traditionally they are immigrants from the plains and still speak a dialect of Kanarese. They are, moreover, much more civilized than most of the tribes included under this category. They follow all sorts of trades, though chiefly agriculturists, they have large and prosperous villages with tiled houses, and generally are much higher in standing than most of the hill tribes. The greater part of them are Lingayats. The Kotas, an aboriginal tribe, are carrion eaters and therefore untouchable. The Todas, though extremely small in numbers and actually diminishing, are important from an anthropological point of view. Drink, venereal disease and debt are their chief dangers. The Kurumbas and Irulas are the shyest of the tribes on these hills and come less in contact with civilized life.

The most important Government effort to uplift the tribes on these hills has been in the way of founding co-operative societies, of which there are as many as 46, including trading societies for the disposal of their produce. There is a co-operative union with a Badaga supervisor which shows promising signs of success. A number of liquor shops have been suppressed. Agriculture has been encouraged, especially potato cultivation. Special grazing and fuel rights have been given to the hillmen and lands have been granted to them with conditions as to alienation. The District Board has opened special schools for the more backward of these classes and scholarships are also granted and books and slates given free. The C.E.Z.M. Society maintains an orphanage for the Todas at Octacamund, special schools at convenient centres and a Toda industrial colony. The Missionary bodies have opened schools for the Kotas, Irulars and Kurumbas.

The Chenchus whose head-quarters are in the *Nallamalai hills* of Kurnool present peculiar difficulties. The Nallamalais contain the largest compact area of reserved forest in India and under the original settlement of these hills the Chenchus are allowed privileges in regard to minor forest produce, grazing, hunting and other rights. They burn the young grass as other graziers do, they burn in order to collect minor produce more readily, they burn to be able to track their game, and they burn for wanton mischief. They are supposed to be the hereditary guards of Srisailam temple, and levy a tax on the pilgrims who go there through the jungle, a fee nominally for protection from themselves. They claim fees for watching the crops in villages near their gudems or settlements, a fee which is little better than blackmail. They carry bows and arrows, which they shoot at the slightest provocation, and are so elusive that it is almost impossible to catch them in the tall grass of their jungles. Though their rights are confined to the collection of minor forest produce, they have no scruples in cutting down the tallest of trees and would not hesitate to shoot down a forest subordinate who dared to restrict them in doing so. The Abkari authorities are not expected to try to prevent their distillation in the jungle for their own use and it is more than they can do to prevent them from disposing of their illicit liquor in the villages outside.

For many years Government have been endeavouring to reform these people chiefly through the Forest Departmeut who have raised many acres of teak and other plantations at Government cost chiefly in order to give them settled employment. Lately a Special Officer of experience with criminal tribes has been endeavouring to civilize them

by teaching them agriculture, by giving them work in splitting bamboos, by opening special shops to enable them to buy grain, by giving them work to do in the special forest coupes when no other work is available, and by looking after them when they are sick (they also are terribly affected with venereal disease). He has gained their confidence in an extraordinary manner, and his labours should ultimately bear excellent fruit, but the place is extremely malarious so that he has been compelled to take leave, and his work has been continually hampered by the irreconcilables who lead the young men astray into dacoity and other crimes, and generally undo in a day what has taken him months to instil.' He has also been extremely unfortunate in being faced with two bad seasons out of three in which he has been working. His hands are now to be strengthened to deal with the offenders; and it is hoped that the Chenchu problem may be solved before the forests are completely destroyed. The forest department on their part are making plans which will give them sufficient work to enable them to earn an honest livelihood, if they will.

The Malayalis of the hills of *North Arcot, Salem, Trichinopoly and Coimbatore* though not aboriginals may claim to be called a hill tribe by right of long continued residence, of backwardness in point of civilization. The Government have endeavoured to prevent them from losing their lands by making special restrictions on alienations to outsiders and have given them special concessions in regard to obtaining lands on favourable terms of assessment. The planters give them an opportunity of earning honest wages and the forest department are giving them employment as subordinates and thus interesting them in the conservation of the forests. A co-operative society has recently been started on the Kollemalais by a missionary, Mr. Brand, who has also opened a dispensary for them. There are five schools for the Malayalis with over one hundred pupils.

On the *Coimbatore* hills of the western ghats, the Sholagars, Kurumbas, Irulars, Malasars, Mudugars, Pulaiyars and Kadars have been taken special care of by the Forest officers, who have allotted them lands free of assessment, employ them as guards, fire patrols, mahouts and in other occupations, have started a special school for them, allow them to collect certain forest produce free of charge and pay them for it on collection, and generally enable them to obtain an honest settled living. No figures are available as to the alienation of their lands or their indebtedness to the money-lenders and these questions demand further inquiry.

In the *Malabar Hills*, Mr. Gray in his investigation of 1917 found the following aboriginal and hill tribes:—

Pulayan, Paniyan, Kurichiyan Kurumba, Karimbalan, Malakkar (Malapanikkar), Malayan, Malasar Nayakkan (Kattu Nayakan) Kadar, Mavilon, Vettuvan, Arunadan, Alan, Adiyan, Pathiyan and Uridavan.

None of these are sufficiently large in numbers to be separately enumerated in the list of castes in the Gazetteer of the district. The figures for the Presidency are given in the table above except in the case of Malakkar, Malayan, Alan, Adiyan, Pathiyan and Uridavan which were not apparently considered worthy of separate record in the Madras Census report. No special effort seems to have been made to uplift these people in the past. Most of them live by petty agriculture or by hunting. Further inquiry will be made by the Commissioner of Labour to see whether any action in necessary. The Kudiyas which the Collector refers to as the only hill-tribe in South Kanara numbered only 4,000 in all and as it is reported that a number of them are not hillmen but live on the plains, the tribe must be an extremely small one.

In the extreme south of the Presidency on the hills of *Madura, Ramnad and Tinnevelly* the Palaiyars, Pulaiyars and the Kanis are the only hill tribes, of which Palaiyars

are much the wildest and shyest tribes in those parts. Kanis have been taught agriculture through the American Madura Mission, church Mission Society have done something towards educating and civilising the Palaiyars. The efforts to induce these Palaiyars to settle and cultivate lands in Ramnad were frustrated by the depredations of elephants.

The Lambadis found chiefly in the Telugu districts are gipsy carriers of salt and grain; they are a primitive people and as such should be given every privilege which is granted to the depressed classes, especially in the way of education and co-operation. Owing to their traditional occupation having been largely taken from them by the bullock-cart and railway some of them have taken to crime as a method of subsistence. Lands have been granted to some of these criminal Lambadis in the Guntur district and the settlement is reported to be a success. Five special schools have been opened for them in the Bellary district.

Like the Lambadis some of Yerukalas have taken to crime. They are a wandering tribe. Apart from the special treatment accorded to the criminal branch of the tribe no special efforts have been made to improve their condition, but they should be accorded every privilege granted to the depressed classes.

The Yanadis are more settled in their habits than the Yerukalas. Their chief centre is in the Nellore district in the island of Sriharikota where they live, fish, catch white-ants, collect minor forest produce for sale, and cultivate the sandy lands of the island. The assessment on the lands is exceedingly low. They are rightly noted as a backward class for purposes of education, and special efforts have been made to improve the water-supply to guard against elephantiasis and other diseases of the places and a travelling dispensary has been established in these parts for some time to deal with malaria. They, like the two previous tribes, need no special protection but should be open to all privileges which are to be granted to others.

Criminal tribes.—The difficulty of giving an enumeration of the criminal tribes in the Presidency is quite as great as with the aboriginals. It is rare to find a whole caste or tribe which has thieving as its chief profession and it would be unjust as well as incorrect to stigmatise the whole tribe as criminal for the sake of an erring section of its members. Thus without doubt some of the Kallars (as their name implies) are hereditary thieves but large sections of them are as respectable as their neighbours. Even in the same district, as Madura, the Kallars of Melur as a body have forsworn theft in a registered document and as a body have fairly kept this oath, whereas their fellow caste men south of the Vaigai refuse to restrain their propensity to thieve. The Valaiyans as a caste are respectable hunters, catchers of rates and of white-ants which they sell for food, but some sections of them in Coimbatore are addicted to crime. The Parayans *are generally a most honest set of depressed* people, but the Veppur Parayans and Vaniyan Parayans have taken largely to crime. So with Boyas or Bedars of the Ceded Districts who formed the backbone of some of Tippu's armies, it would be a grave error to call the Boyas as a whole criminal tribes, because of the evil habits of the Boyas of Kurnool. Not all the Dommaras, those excellent acrobats, are thieves. The Konda Doras include several hill chieftains who would rightly be insulted if any slur were cast upon the tribe as a whole. The Padayachis are, as a general class, excellent farm labourers. The Jogis are beggars and pig-breeders as a caste; some of them are employed as cultivators, destroyers of pariah dogs and scavengers; it is a comparatively small section who go in for robbery and dacoity.

The following table, therefore, which shows the different tribes registered under the Criminal Tribes Act, must not be understood to suggest that the total number of the castes and the tribes mentioned are addicted to crime :—

Name of criminal tribes	Districts
Donga Yerukalas	Godavari, Nellore, Guntur, Kistna, Kurnool, Bellary and Cuddapah.
Vayalpad or Nawabpeta Korachas ...	Chittoor, Anantapur, Salem, Cuddapah, and Nellore.
Donga Dasaris	Nellore, Kurnool, Guntur, Kistna and Godavari.
Veppur Paraiyas	South Arcot.
Donga Woddars	Kurnool, Anantapur, Cuddappa, Nellore, Guntur and Kistna.
Togamalai Koravas or Kepmaris	Trchinopoly, South Arcot, Chingleput, North Arcot, Cuddapah and Salem.
Rudrapad Korachas	Bellary.
Dommaras	Nellore.
Salem-Melurnad Koravas	Salem, Coimbatore, Trichinopoly and North Arcot.
Attur-Kilnad Koravas	Salem, South Arcot and Trichinopoly.
Nakkalas	Godavari.
Gandharvakottai Koravas	Tanjore.
Vanganur Paraiyas	North Arcot, Chittoor, Chingleput and Nellore.
Jogis	North Arcot, Chingleput, Chittoor, South Arcot and Nellore,
Gang of hired assassins of 28 persons frequenting	Cuddapha, Kurnool and Anantapur.
Kilagudi Kallas	Madura.
Kondadoras	Vizagapatam.
Vellayankuppam Padayachis	South Arcot.
Kuttapal Kallas	Trichinopoly and Tanjore.
Chettinad Valayas	Ramnad.
Rellis	Vizagapatam.
Sorikkampatti Kallas	Madura.
Mela Urappanur Kallas	Do.
Pusalapuram Kallas	Do.
Uppa Koravas of Koilpattu and Anavaradanallur	Tinnevelly.
Vaduvarpatti Koravas	Ramanad, Madura and Tinnevelly.
Paidis	Vizagapatam.
Sakkaraitamadai Koravas	South Arcot and North Arcot.

Name criminal tribes	Districts
Telaga Pamulas	Ganjam, Vizagapatam, Godavari, Kistna, Guntur. Nellore, Kurnool and Cuddaah.
Donga Dasaris	Bellary, Cuddapah, Chittoor and Anantapur.
Urali Goundans of Dhulipatti	Trichinopoly.
A section of Koravas in Koilpatti taluk ...	Tinnevelly.
Nattam Korachas	Chittoor.
Boyas	Kurnool.
Piramalai Kallas	Madura.
Karavas a *section in Hosur taluk*	Salem.
Maravars of Poolam in the Nanguneri taluk ...	Tinnevelly.
Twenty-one sections of Valayas	Coimbatore.
A gang of Anippai Malas and a Chetti ...	Godavari.
Oriya Dombs in Jeypore	Vizagapatam.

The assassins of Cuddapah are *not a tribe* at all, even that dangerous tribe the Donga Dasaris of Bellary *recruit their members* from outside. On the other hand it is to be feared that this list cannot be said to be exhaustive of the castes, tribes, or sections of them addicted to crime. It does not include the Chenchus already mentioned, the Tottiyan Naicks (the criminal members of whom form very dangerous gangs) the Ghasis, horse-keepers many of them but many also hereditary criminals, the Lambadis some of whom have already been noted to have turned criminal, and the Kalingas (only a small section of the caste) whose depredations are not confined to the Presidency.

The principal steps which Government have taken up to now for the reformation and uplift of the criminal tribes have been the granting of land to them and the establishment of criminal settlements. Special rules have been in force in the Madura district for some years giving a preferential right to the Kallars who are willing to take up land and thus secure *economic freedom* and make themselves independent of the necessity of earning their living by crime. In Guntur a large area has been set apart for certain criminal Lambadis. Among the Kallars *owing to the special efforts made by* M.R.Ry. A. Vedachalla Ayyar Avargal (now acting Registrar of Co-operative Societies) a large number of societies were started to teach them the virtues of thrift; unfortunately after he left, the interest shown in the societies dwindled to some extent and some of the societies fell into arrears, but with the high price of cotton, the chief staple of the tract, it should now be possible to re-establish them on a sound basis. Reference has already been made to the work done by the Chenchus under the heading of aboriginals. An attempt to start a basket trunk making factory with a boarding school started for the Koravars in Ramnad has been recently made by the Rev. Mr. Jefferis with the assistance of Mr. Loveluck, District Superintendent of Police. Under education the criminal tribes have all the privileges of backward classes, but as there is generally speaking no caste objection to their admission into the ordinary schools, no special schools have been set apart for them except in the criminal settlements.

It is in these settlements that the chief attempt at reforming the tribes has been made, The location, of inmate's number and the agencies which are attempting the reformation are given in the following table:—

Name of settlement	Number of inmates	Agency
Sitanagaram Settlement, Guntur district ...	720	The Salvation Army,
Stuartpuram do do ...	1,524	do.
Bhumannagadda Settlement, Chittoor district ...	476	do.
Kavali, Allur and Bitragunta Settlements, Nellore district	1,860	The American Baptist Mission.
Aziznagar Settlement, South Arcot district ...	995	Government.
Reformatory Settlement, Guntur district ...	158	The Salvation Army.
Reformatory Settlement, Perambur Barracks, Madras	219	do.
Pallavaram Industrial settlement, Chingalput district	178	do.
Kulasekharapatnam Settlement, Tinnevelly district.	176	East India Distilleries and Sugar Factories, Limited.
Sidhapuram Settlement, Kurnool disirict ...	207	Government.
Kalla Settlement, Gudalur, Madura district.	26	Madura American Mission.

It will be seen that by far the greater part of the work is undertaken by missionary bodies, and Government are of opinion that as far as possible there should be some religious or philanthropic agency attached to each settlement. Of the mission settlements, all but two are in charge of the Salavation Army which has a special organization for this work and has made it a part of its duties to attempt the reclamation of the criminal all over the world. The members are inspired with zeal and enthusiasm as well as experience, all of which qualities are most necessary for this most difficult and sometimes dangerous work. The Army has the great additional advantage that owing to the great size of the organization they are able to provide a substitute for any of the managers who should fall ill or have to take leave for other reasons or be found unsuitable for the particular post he holds. Up till now, these great advantages have been to some extent neutralized by other drawbacks. The great distance of Simla, the Army Head-quarters in India, from this Presidency, has entailed some difficulties in the co-ordination of the work with Government and with individual managers, and the fact that managers themselves are liable to be transferred all over India has made the acquisition of the Vernacular an impedient to the influence of some of the best of their workers. Hereafter the Army in India is to be divided and there is to be a Special Commissioner for Southern India and Ceylon, so that both of these difficulties should shortly disappear. Two other missionary societies and one business firm are giving their services to this work.

The object of a criminal settlement is the reformation of the inmates by inducing them to lead a settled life, to give them an opportunity of earning a regular income apart from crime, to break them of their idle.

vicious and restless habits by regular discipline, by removing the temptation to crime and to drink and by holding out hopes of an independent life as farmer or artificer when they have shown by their continued good work that they are worthy of freedom. As a general rule when members of a tribe are admitted to a settlement, they are lazy and inefficient and unable to undertake any but the simpler forms of manual labour and often nnwilling to undertake that. By tact and pressure they are taught to work regularly at quarrying as at Sitanagaram or at Pallavaram, at reclamation of land or at earthwork, as in Kavali, Stuartpuram, Aziznagar or Bhumannagadda. As they show themselves worthy of confidence or capable of better things, the settlers are taught a regular industry such as leather-making in Pallavaram or rope-making at Bhumannagadda, and weaving both cotton and silk in most of the settlements or are given land to cultivate with no rights of alienation but with the hope of making the land their own ultimately and settling down as regular farmers. The most reliable of the settlers are given work as maistris or as settlement police ; it is the policy of the Government to exclude as far as possible the police from the settlements as they are a continual reminder of the old criminal life of the tribe. These official positions are much coveted by the settlers and give them a standing and a responsibility of their own which has an excellent reforming effect. The Government have also under consideration the question of forming a new penal settlement for the most refractory of the tribes, as the efforts of the settlement managers are in many cases set at naught by a few determined criminals, who are unamenable to discipline themselves and are constantly interfering with the smooth working of the settlement and leading the other members, especially the younger members, astray.

Medical relief is generally given to the settlers by periodical visits from the nearest Government Medical officer. In Sitanagaram the Salvation Army has provided a medical officer of their own and in Stuartpuram a dispensary building has been built and should shortly be occupid by a medical officer. In addition to this, practically all the managers and their wives have some knowledge of the rudiments of medicine, and their care and attention to the sick is one of the most striking and promising features of the settlement work. Gratitude is no mean motive for reform.

The most important factor of all in settlement work is the education of the children. It is a matter which has been much debated whether it is not better in the interests of the children to remove them entirely from their surroundings and to give them a new start in life where they will be absolutely untainted by a criminal environment. But against this must be set the fact that the removal of the children from a settlement removes one of the chief ties which bind the settler to his house and to a more steady way of life. The best compromise between these two conflicting views is that adopted by the Rev. S. D. Bawden at Kavali, where there is a boarding school in the settlement in which the children live and are educated, but the parents are allowed to see them under supervision and are not entirely separated from them. This method will probably shortly be extended to Bhumannagadda, Sitanagaram and Stuartpuram, where there is already an embryo boarding school. Meanwhile in all the settlements schools have been established. At first considerable opposition was encountered from many of the settlers especially against the education of the girls: but this has now been almost entirely changed and the happy eager faces of the children are one of most delightful features of a visit to a criminal settlement. As they grow up they are taught leather work, weaving, rope-making or agriculture to fit them to take their places ultimately as respectable members of society.

The following table shows the number attending school in each settlement :—

Settlement	Number of children receiving education
Sitanagaram	94
Stuartpuram	200
Bhumannagadda	96
Kavali, Allur and Bitragunta ...	326
Aziznagar	95
Reformatory settlement, Guntur ...	20
Do. Madras ...	29
Kulasekharapatnam	34
Sidhapuram	52
Kalla	3

In addition to the schools in the settlements there are two schools, one a Salvation Army Boy's school now at Bangalore but to be transferred to Perambur, when a building for it is completed and a Salvation Army Girls' school at Nellore. These two schools are to be constituted as industrial schools but, pending the construction of buildings for the purpose, are at present intended for the children whose parents have died, have absconded or are in jail. The fact that absconding means the loss of the children has a wholesale retentive effect.

Mistakes may have been made in the past and great difficulties been encountered at the beginning of this work, but the general lines on which the settlement of these tribes should proceed, have now been laid down and if work be continued on these lines there can be little doubt that there will be a wonderful difference in the next generation of the tribes and that a great reforming work will have been carried out. Already the smiling gardens of Stuartpuram, with rubber, mangoes, casuarinas, tomatoes, and potatoes growing on what was a waste of sand shows what can be done by a man of energy and capacity like Mr. Robilliard of the Salvation Army. In Kavali the most deserving of the settlers have been given practical freedom on their own lands and in their own houses at Allur.

The Veppur Faraiyans of Pallavaram turned out wonderful boot-soles for the soldiers during the war and are now providing the police whom they used so much to dread with the foot-gear that will enable them to pursue the criminal into his thorny fastnesses. The next generation will have a fair chance to forget that they are criminals by birth and by tradition.

Untouchables.—As observed by the Board of Revenue in their Proceedings No. 60, dated 18th March 1918, which should be read by all those interested in the subject, the question of the amelioration of the untouchables is a much larger problem than that of either aboriginal or criminal tribes. They form about 17 per cent of the entire population of the Presidency and in some districts the proportion is naturally higher. The following table shows the number of untouchables for each district in the Presidency and the proportion which they bear to the total population of each district :—

District	Total population	Number of untouchables	Percentage of column (3) to column (2)
1.	2.	3.	4.
Chingleput ...	1,406,008	3,83,054	27·24
South Arcot ...	2,362,566	6,26,342	26·51
Godavari ...	1,445,957	3,57,890	24·75
Kistna ...	1,997,535	4,61,173	23·08
Tanjore ...	2,362,689	5,07,642	21·48
Nilgiris ...	1,18,618	24,504	20·65
Nellore ...	1,328,152	2,49,286	18·77
Trichinopoly ...	2,107,029	3,86,065	18·32
Tinnevelly ...	1,790,619	3,20,805	17·91
Chittoor ..	1,238,742	2,11,827	17·10
Madura ...	1,932,832	3,20,084	16·56
North Arcot ...	1,960,960	3,22,411	16·44

District	Total population	Number of untouchables	Percentage of column (3) to column (2)
1.	2.	3.	4.
Coimbatore ...	2,116,564	3,20,572	15·14
Ramnad ...	1,658,453	2,38,946	14·40
Salem ...	1,766,680	2,52,784	14·30
Anantapur ...	9,63,223	1,28,153	13·30
Cuddapah ...	8,93,998	1,15,391	12·90
Kurnool ...	9,35,199	1,18,445	12·66
Guntur ...	1,697,551	2,11,823	12·55
Bellary ...	9,69,436	1,16,944	12·06
Madras ...	5,18,660	60,835	11·73
Vizagapatam ...	2,169,670	2,16,973	10·00
South Kanara ...	1,195,227	1,11,079	9·29
Malabar ...	3,015,119	2,63,247	8·71
Ganjam ...	1,870,826	1,58,501	8·47
Total ...	39,822,313	6,484,776	..

In no less than six districts of the Presidency more than one person in every five is theoretically not allowed to come within a distance of 64 feet of the higher castes without pollution. The purificatory ceremonies are now generally neglected except by the most orthodox but in some parts especially on the West Coast, the restrictions are still very strong. Mr. Thurston, for example, gives an instance where some outcastes whom he wished to measure had to come many miles round to cross a river lest they should pollute a bridge by their presence. In the Malabar District Gazetteer published as recently as 1915, it is stated as a fact that even to this day the Nayadis who live largely by begging have to leave their cloths on the road-side and retire to some distance whence they call out to the passersby to deposit their alms upon the cloth. Slavery has been forbidden for many years by the Penal Code but in C.A. Nos. 26 and 27 of 1917, the High Court of Madras had a case before them which they instance as an undoubted example of the sale of a slave. The public water-supply is absolutely forbidden in nearly every village to castes which number one-sixth of the people of the Presidency. Last year an English gentleman, a pronounced nationalist, while driving through a municipal town with a student was surprised at a request from his neighbour that he might be allowed to get out and walk and rejoin him later on. He was still more surprised to find when his companion returned that his reason for descending was that owing to his caste he was not allowed to pass through a particular street. Theoretically all Government offices are open to persons of every class and creed, but a rich and respectable gentleman recently returned from abroad informed the writer of this note that he was made to go outside a certain public office when it was discovered that he was of low caste. In the recent Ganjam famine, it was found necessary to provide work for the outcastes on a different part of the works from the other labourers. Even in the presence of actual famine, the rules of distance had to be obeyed.

On a respectable Panchama gentleman being appointed to a seat on a municipal council five of the members including a Mohamedan immediately sent in their resignations and were with difficulty induced to withdraw them. Though in theory all schools financed with public money are open to all classes of the community, in practice there have been great difficulties in giving effect to this policy. Many of the hamlets where these people live, especially in the delta districts, are extremely congested and insanitary. Many of them are cut off from access to the main village or the road except at the good will of the owner of the fields they must traverse. To get to their water-supply (such as it is) or to their burial or burning ground, they are often similarly at

the mercy of the land-owners. In many districts the Panchama field labourer is so tied up by dept to his master (who takes care that the debt shall not be redeemed) that he is practically in the position of a serf. The system of man-mortgage by which the labourer binds himself and frequently his heirs to service till a debt is redeemed is well-known. Mr. Gray, in his recent report on the condition of these classes in the Chingleput district, was able to reproduce documents in which the entire property of the lahourer was mortgaged to the master, so that the Panchama is completely at his master's mercy. In some cases the masters, afraid that the courts may refuse to recognize the validity of these agreements for service in exchange for loans, induced the labourer to mortgage his house-site instead, or to give an acknowledgment that the house is not his own but his masters. This difficulty of house-site is specially in evidence in the 'mirasi' districts where the farmers claim that every acre of land including waste and poramboke, is their own, and the field labourer, even if by emigration to some other district or country he is enabled to acquire a competence, is still at the mercy of his master if he wishes to return to his home. It would, of course, be a mistake to suppose that the masters always use the great power they bave unwisely, or that the labourer does not occassionally obtain advantages from remaining under a kind mirasidar; such as presents at festivals, assistance at the time of marriage, and especially in the way of necessary subsistence during the slack season, when little regular employment is available. Such arguments, however, would apply with equal force to any system under which the personal liberty of the servant is at the mercy of the master; and Government have decided that this system is bad and must be discouraged in every possible way. In the course of the Special Officer's inquiries in Tanjore and other districts, it has been found that in many parts the Panchama, whether labourer or small farmer, is continually a loser in buying the ordinary necessaries of life and in disposing of his produce through his inability to enter a shop or even to pass through many of the streets where the ordinary shopkeeper lives. In many cases by actual testing it has been found that the Panchama loses a large percentage on every deal. With such disabilities and such degrading conditions of life combined too often with wages which are distinctly low, it is not surprising that the Pauchama labourer frequently endeavours to forget his troubles in liquor. Nor is it to be wondered at that a large number of them, home lowing though they are, seek to improve their economic and social position by migrating to countries where they can hope to rise to a higher status.

Before proceeding to discuss what has been done already and what more can be done towards the solution of the problem of the Panchama, it is necessary to guard against two possible misconstructions. In the first place, the examples quoted in the preceding paragraph of the hardships and disabilities with which the Panchama has to contend are simply put forward to show the gravity of the problem as it exists at present and not in any sense as an attack on any system of society or religion. Nor in the second place, is it intended to disparage in any way the great advances which have already been made in this presidency, perhaps more than in any other, as was admitted in the debate on the subject in the Imperial Legislative Council.

Of the methods which are open for the uplifting of the Panchamas the most obvious is education. When the Panchama has come under missionary influence and received some education, the difference in his cleanliness, self-respect and capacity for higher things is remarkable. The Panchama child is as was recently observed by the head of one of the non-Christian societies in Madras by no means a fool. On the contrary he is often very quick to learn and responds

admirably to the efforts made on his behalf. In the last quarter of a century the number of Panchama pupils in public institutions (including aided schools) has risen from thirty thousand to well over one hundred and fifty thousand, or 400 per cent. The number of public institutions in which they are being educated rose in the same period from fourteen hundred to more than five thousand. In 1892 there were only eleven primary schools for girls; there are now a hundred. Much has, therefore, been done already, but how much still remains to be done is clear from the fact that till now only 2 per cent of the total number of these people are in school, which is less than half the percentage of attendence among the remainder of the population of the Presidency. Moreover, as the following table will show, the different districts vary extremely in their rate of progress:—

District	Panchama population	Panchama boys and girls	Percentage to total Panchama population [column (3) to (2)]	Percentage of boys girls at school out of the general population.
1	2	3	4	5
Madras ..	60,835	6,281	10·3	11·8
Guntur ...	211,823	11,721	5·6	5·5
Nilgiris ...	24,504	1,014	4·1	6·1
Kistna ...	461,173	14,242	3·0	5·4
Nellore ...	249,286	7,125	2.9	3·5
Ganjam ...	159,501	4,280	2·7	3·4
Godavari ...	357,890	8,997	2·5	4·6
Chinglepet..	383,054	8,683	2·3	4·3
Tinnevelly..	326,805	7,117	2·2	5·7
North Arcot	322,411	5,431	1·7	3·7
Madura ...	320,084	5,386	1·7	3·5
Vizagapatam	216,973	3,716	1·7	2·5
Kurnool ...	118,445	1,941	1·7	4·0
Bellary ...	116,944	1,877	1·6	3·3
South Arcot.	626,342	7,522	1·4	3·4
Chittoor ...	211,827	2,936	1·4	3·1
Trichinopoly	386,065	4,929	1·3	3.4
Tanjore ...	507,642	5,989	1·2	4·8
Ramnad ..	238,946	3,788	1·2	3.9
Coimbatore.	320,572	3,911	1·2	2·9
Cuddapah...	115,391	1,306	1·1	3·5
Malabar ...	263,247	2,755	1·0	6·4
Salem ..	252,784	2,267	0·9	2·3
Anantapur...	128,153	1,019	0·8	2·9
South Kanara	111,079	541	0·5	4.5
Total ...	6,484,776	124,774	...	...

In Madras City where the general standard of education is high and there is a real movement for the elevation of the depressed classes, and the opinion of the public in the matter is being awakened, the proportion of educated persons is almost as high among Panchamas as among the general population. The same is true to a less extent of Guntur, Kistna and Nellore where the Christian population is large and missionary influence has been brought to bear. In places like Malabar and South Kanara though the general standard of education is high (Malabar is first in the Presidency outside Madras) only one per cent in Malabar and a half per cent in South Kanara among the Panchamas are reading in school. The work of the various missionary societies in giving education to the Panchamas is beyond praise. They have over 3,500 schools with nearly a hundred thousand pupils. In former years the proportion of Panchama schools under mission management was much greater; in 1892 fourteen out of every fifteen were managed by these bodies. Moreover not only were the missions pioneers in the education of the Panchama in schools of his

own, but by their resolute stand in insistingo that he should be admitted to their higher educational institutions they gave him the opportunity hê needed to raise, and created a body of public opinion among their other students who were ready to treat the Panchama as a fellow human being. This good work is now being assisted by a number of other than Christian societies; in Madras City schools are maintained by the Theosophical Society, the Depressed Classes Mission, the Southern India Brahmo Samaj, the poor School Society, the Social Service League,the Triplicane Sociological Brotherhood, and the Brotherhood, Royapetta. In Mangalore, the Depressed Classes Mission maintains a number of schools; in Masulipatam the Sri Vidyanivedika Deena Samrakshaka Sangham, in Chidambaram Swami Sramananda have done good work and in many other places throughout the Presidency similar work is being started. The importance of the work of these societies is not merely to be estimated by the number of pupils they teach, and the number of schools they maintain. Everywhere they have a great influence on public opinion, especially on the opinion of the University student, and he in his turn when he goes back to his village, becomes a centre of light and learning in the matter. It is the son who rules the mother and the mother rules the family. Shortly it is to be hoped that public opinion will become so strong that principal Hindu institution in madras will open its doors to the Audhi Dravidians.

Special concessions have always been given by Government for the encouragment of Panchama education. They may be admitted in the elementary schools under public management free of charge and at half rates in the secondary schools. Increased rates of stipends in Government training schools and of stipendiary grants in aided training schools are allowed to Panchamas and a separate training school for Panchama masters is maintained at Madras. Until the recent abolition of the capitation grants, special increased grants were given for Panchama pupils. Now that capitation grants have been abolished the inspecting officers have been directed to take the number of Panchama pupils in a school into account in arriving at the grant-in-aid. Special scholarships are being granted for Panchamas in secondary schools and this number can be increased if suitable candidates are available. And finally Government have decided that all schools under public management should be accessible to the Panchamas.

In carrying out his policy it has been ordered that where such a school is situated in a place inaccessible to these classes, steps should be taken at once to move it, and that no school building shall hereafter be constructed out of public funds unless it is certified that it is in a locality accessible to all classes. But while there can be no doubt that this policy of insisting upon the admission of Panchamas to all schools is the right one from its educative effect both upon the Panchamas and their higher caste brethren, it will also probably be necessary to create and maintain a large number of schools intended chiefly for the Panchama, field-labourers' schools which are open to all classes but which will chiefly be used by the members of the Panchama class.

At one time there was room to fear that the schools for Panchamas were not always inspected in the paracheri itself. This has been now made compulsory.

Questions which still remain for decision are the kind of training which is to be given to the young Panchama, whether a purely literary training is not a mistake and a training of a vocational character would not make the Panchama realize the value of education and be ready to allow his children to remain at school for longer periods. A special Government Committee has recently been sitting to consider the question of rural education. A special committee of the

missionary bodies is shortly to tour round India to consider such problems. Every one is awake to the importance as well as to the difficulty of this question and shortly by united efforts a solution should be found. Meanwhile special attempts are being made by the American Baptist Mission in Cocanada, by the A. E. L. M. Mission in Guntur, by the S. P. G. Mission in Kurnool, and the American Mission in Madura; one of the greatest difficulties will be the question of the training of teachers, but the combined efforts of the Agricultural and Education departments with private efforts working in healthy rivalry should be able to produce a suitable scheme.

Almost of equal importance with education is the co-operative movement, which teaches the Panchama the virtues of thrift and self-respect and gives him something to live for and to look forward to. There are now over fourteen thousand Panchama members of co-operative societies, nearly three times the number there were five years ago, and a special effort is to be made next year to advance the cause. There are 233 societies with over 25 Panchama members, and 118 purely Panchama societies. More than half the municipalities in the Presidency have organized their scavengers into co-operative societies and it is hoped that this example will shortly be followed throughout the Presidency. A very successful society has been started among the salt loaders of Madras.

Christian Missions, Social Service League, Depressed Classes Missions, Young Men Christian Association, and other similar associations are vying with each other in organizing and supervising co-operative societies for the poor people. The Christian Central Bank is financing many such societies on special terms. In Cuddapah and Anantapur in particular the London Mission has specially directed its activities to this important work. The Government have afforded the Panchama societies special privileges in the way of supervision. As in the case of education, the balance of opinion seems to be that though the ideal to be aimed at is to absorb the Panchamas into general societies and unions and this policy of admitting Panchamas should be pressed on every possible occasion, yet for some time to come it will be necessary to organize societies composed chiefly of Panchamas, field-labourers' societies, which will require closer supervision than others and where the Panchama will not only have the privilege of being a member of the society, but have a share in its management and control.

Special efforts have been made in Tanjore by the Deputy Collector M.R. Ry. D. Arulanandam Pillai Avargal appointed to acquire house-sites for Panchamas at their expense. Over fifty societies have been organized (in 1917—98 there were only 43 Panchamas societies in the whole Presidency). More than fifty thousand rupees has been put down for the acquisition of house-sites by the Panchamas themselves who have pledged themselves to pay in instalments two lakhs and a half; experiments have been made in co-operative trading and ordinary work in co-operative credit has gone on simultaneously. In Godavari, where a Special Deputy Collector has been working for acquisition of house-sites, twenty co-operative societies have already been formed and similar work to that which has been so successful in Tanjore has been begun.

No figures are available for the work done up to the present in supplying water to the Panchamas, but much has been done by local boards and by private efforts. In perticular Mr. Pandiyan has opened more than a hundred wells for these people. In Tanjore the Special Deputy Collector is trying to arrange for water-supply as well as for house-sites. Much however remains to be done and the demand of the poorer classes for water-supply should take precedence of more fastidious persons. If orders be passed that no public money should be spent on

water-supply for particular classes, till a supply open to all is assured, the pace at which these poor people are supplied would be appreciably quickened.

Land.—Government have already ordered that suitable land must be reserved for Panchamas in each district and allotted to them under special conditions. The rules for assignment of general waste lands have also been modified to enable the Panchama to obtain land. There is room to believe that not much has been done in most districts to carry out these orders, pending the more urgent necessity of providing land for soldiers, who have fought for their country (this includes probably more of the depressed classes than of any other Madras caste). Now that these lands have been selected and reserved, the work of assigning other available lands to the Panchamas will be pushed on. In particular in Chingleput district, this problem has been under the consideration of Government since 1892 when its attention was drawn to the matter by the Collector of the district (Mr. Tremenheere). Some seven hundred acres have been assigned under the orders of Government; in South Kanara under the direction of Mr. M. E. Couchman, the then Collector, a considerable number of small plots have been assigned as house-sites and backyards to landless labourers including Panchamas. In Guntur 140 acres have been assigned to the American Baptist Mission for two settlements for Christian Panchamas. In Kurnool 200 acres have been granted to the same mission for this purpose. In North Arcot and Trichinopoly 240 acres have been similarly assigned to these Roman Catholic Mission while in South Kanara 800 acres have been assigned to the Basel Mission, to the Roman Catholic Mission and the Depressed Classes Mission for the settlements of the Panchama Christians. All these settlements are granted on conditions as to alienability and to assessment which make it impossible that they should be transferred to caste people who, it is found too often, use the Panchamas as a cloak behind which to hide their own application.

It is for this reason that the colonies under mission and other private management are so alluring. Perhaps the most successful of them is that started by the Rev. Mr. Andrew in Melrosapuram, Chingleput; a further experiment which is under consideration is the allotment of agricultural land to a co-operative society on similar terms to the allotment of house-sites acquired by the Special Deputy Collector in Tanjore. This would insure against alienation, would provide the necessary credit and thus the necessary capital and would enable the community to get rid of the lazy and inefficient members of the community who proved unfit to make farmers. Experiments are now being made on these lines in Chingleput and North Arcot districts.

Temperance.—Efforts to deal direct with the drink evil have chiefly been made by private societies, temperance societies, social service societies and others who have endeavoured by precept and by example to draw away the Panchama from his favourite vice. Co-operative societies by giving the Panchama a method of saving have had an excellent effect already in this direction especially among the scavengers of the municipalities. In Tanjore many of the societies started for the acquisition of house-sites have induced their members to give up liquor. Attempts have been made to offer counter-attractions by opening tea and coffee shops, which have not however proved a general success. Sale of food with drink has also been abondoned as it tended to take the shape of spicy producers of thirst. The policy of Government has been to produce the maximum of revenue with the minimum of consumption; to this end the taxation on the unit of intoxicants has been very largely increased and at the same time over eleven thousand shops have been closed.

Shop sites have been removed from the road sides; orders have been passed that all shops should be open to streets, private bars being abolished. Attempts have been made to substitute a weaker liquor. Temperance teaching has been introduced in schools. Licensees are severely punished if they sell liquor for credit or exchange for anything but cash or permit drunkenness on the premises. In order to show to the public that Government are determined to raise the status of the Panchamas as far as in them lies, appointments have been made by nomination to a number of local bodies and recently to the Provincial Legislative Council and to the Corporation of Madras.

Finally, to carry out all the schemes for the betterment of the depressed classes, a Commissioner of Labour has been appointed whose chief care it will be to see that their interests are advanced. Under his guidance it is hoped that a large staff will be maintained whose object it will be to attend to the improvement of water-supply, the advancement of education, the institution of co-operative societies, the improvement of housing conditions including the acquisition of house-sites, the provision of access to house-sites, burial grounds, water-supply and the like; to the granting of lands, the foundation of mission or co-operative colonies and all other similar means which may suggest themselves for the amelioration of these classes.

It is announced that a remarkable bed of chalcostilite has been discovered in the valley of the Ouad Cherrat at a place called Rar el Anz, about forty miles east of Casablanca (Morocco). The crystals of the chalcostilite are stated to be remarkable both for their size and for their beauty.

ECONOMICS IN THE WEST.

Industrial Unrest.

London, 19th February, 1920.—In an economic sense the situation is steadily improving. Here as in India we still have industrial unrest but the movements are spasmodic and sectional and no longer threaten as they did a few months ago a violent upheaval calculated to do untold injury to the country's interests. We are doubtless not yet out of the wood and it may be admitted that there are still some very dangerous questions to settle, but the signs are that the worst of the industrial storm has spent itself and that we are really settling down to hard work and production—the only real cures for the diseases from which our body politic is suffering. An excellent effect has been produced by the firm attitude the Government took up in the debate on the nationalisation of the coal mines last week. The Premier's plain speaking, his emphatic statement that the Government would fight to the last with every resource of the state any attempt to override the constitution by a general strike to force nationalisation upon the country, has had its effect. There is less talk of direct action on the part of the wild men of the Labour party, and so prominent a Labour leader as Mr. Brace, the Welsh miners' representative has gone out of his way publicly to repudiate the principle and to outline a perfectly legal and inoffensive plan of campaign, the leading feature of which is the raising of a fund of a quarter million pounds to provide a Labour candidate for every constituency in the country.

The prevailing optimism as to the trade outlook is reflected in an interesting speech made in the House of Commons on Monday by the Chancellor of the Exchequer. Mr. Chamberlain was speaking on the question of a capital levy which the leader of the

Labour party (Mr. Adamson) who spoke before him, had declared to be inevitable. Arguing that this judgment was overhasty Mr. Chamberlain declared that he for one was not convinced that we would have to resort to any such expedient to meet our liabilities, great as they were. The signs of the times, he proceeded, were re-assuring. Trade was good, the export trade was reviving. The very fall in the exchange which in many ways hit us very hard as great purchasers of American produce, was in itself a great County to our export trade, and was bringing orders to our ports which otherwise would never have come here. That was the way we met our difficulties in the past. It was not by rash experiments of a dangerous kind. It was by sound known methods of finance, by encouraging the recuperative powers of the country, that we should find our salvation. He believed that these measures, wisely, courageously and presciently applied would be quite sufficient to carry us through our difficulties, and we, perhaps as well as those who looked at us from a distance would be astonished a generation hence at the ease with which we were able to carry the enormous burden of the war. There is an unmistakeable ring of confidence in these words. They but confirm the widespread impression that the worst of our difficulties are past.

INDIAN EXCHANGE.

Though the general commercial public were startled at the time by the Government announcement of their intention to replace the rupee on a gold basis at the rate of ten rupees to the sovereign, all responsible opinion applauds the decision as a wise and timely measure calculated to restore stabiity to the Indian exchange. There are riticisms of the step, of course, but they ome mainly from sectional interests which ave been prejudiced by the fixing of exhange at so comparatively low a rate. enerally speaking, the feeling is that the fficial policy will be to the benefit both of India and Great Britain by stabilising conditions which have long been so erratic and uncertain as seriously to prejudice trading operations. Of the excellence of the outlook for the British manufacturer there can be no question if we apply to India Mr. Chamberlain's statement in reference to the influence of adverse exchange on British trade with America. To all intents and purposes the high rate of exchange is a bounty on the importation into India of British goods. Mr. E. M. Hughman, of Mops Pyne, Hughman and Co. of Calcutta, and hon. organizing Secretary of the Indian Society of Engineers (now the Institution of Engineers, India) has just published some interesting opinions on this subject in the *Times Trade Supplement.* As they are typical of views held in well-informed Anglo-Indian trading circles I venture to quote them:—

As a large importer of machinery, Mr. Hughman is of opinion that the British manufacturer apparently does not realize the glorious opportunity which he now has of capturing practically the whole of the trade in India and the Far East. "Various statements have been made regarding the trouble with exchange, but whatever it may mean to the rest of the world, at the present moment and for some considerable time to come it certainly means that the British manufacturer can export his goods to markets outside Europe at prices which will show the purchaser a considerable saving over dealings with certain other countries.

"If we take, for example, the question of trade with India at the present rate of exchange, one rupee purchases goods to the value of 2s. 8d. The pre-war value of the rupee was 1s. 4d., and further comment on this point is unnecessary."

There is, of course, a reverse to this picture, one with which the importer of Indian products is only too well aware. But on the whole I think the balance of advantage is with India. She gets manufactured goods which she cannot at the present time produce with advantage herself, at a low cost, and she sells her cotton, her jute, her tea and coffee and her indigo at top prices to the enrichment of her agriculturists. The cheapening of imported manufactured goods, of course, may be carried to the point at

which it will retard Indian industrial development, but we are a long way yet from that stage in the trade movement and probably there will be a reaction before the time when Indian industries are sufficiently advanced to meet anything like the whole of the domestic need of the country.

THE SUGAR TRADE.

Meanwhile, Indians will be well advised to take note of the factors in the world situation which are making for Indian development on lines which she can immediately follow with advantage. The sugar trade supplies are an excellent case in point. Not for many years, if ever, was there such a splendid opening for sugar production. There is a world shortage of the commodity which is not likely to be overtaken for many years. Present prices are abnormally high and the chances are that they will remain so for a long period. India is *par excellence* the country for sugar cultivation. In the valley of the Ganges and in many other parts of the continent are vast tracts peculiarly suitable for the cultivation of the cane. Yet India has been so neglectful of her opportunities in the past that she does not to-day produce all the sugar that she needs. How enormously her production may be improved even on its present basis of cultivation is shown in an illuminating article contributed by Professor P. Carmody, F.I.C., late Director of Agriculture, Trinidad, to the *Times Trade Supplement*. Mr. Carmody describes at some length the history of the pioneer sugar factory in Antigua, British West Indies, and demonstrates that the system of Co-operative working there introduced has been an enormous success yelding a very high return on the money invested and increasing considerably the output of sugar per ton of canes crushed. The point which the writer emphasises is that the good results attained at Antigua are due to improved methods of manufacture rather than to any appreciable extension of the area under cultivation. "In Antigua, as in other places, under the old processes 15 tons of cane produced only one ton of sugar; in the new factory ten tons at first, and less than nine tons since the addition of the fourteen-roller mill, produce one ton of high-grade sugar. During the 15 years 100,000 tons of sugar have been produced from 928,000 tons of canes, which under the old process would have produced only 62,000 tons of sugar—a clear gain of 38,000 tons of sugar, worth £431,000, and of this sum more than half has been returned to the cane growers." Mr. Carmody calculates that if the Antiguan system is applied to India there should be a possibility of increasing the present production of 2,600,000 tons to over 4,000,000 tons. His final judgment is that "no other part of the Empire possesses greater possibilities for relieving by a substantial amount and within a reasonable time the shortage in the world's supply of sugar." It is probable that Mr. Carmody's estimate of what is possible is exaggerated as India in recent years has made great strides in the matter of scientific sugar production. At the same time there is much in his paper which should commend it to the serious consideration of those who are prominently concerned in stimulating Indian Industrial development.

PROGRESS OF HOME TRADE.

Reverting to the subject of the progress of home trade I may state that those who have lately been in the manufacturing districts are greatly impressed with the tremendous energy which is being exerted in many directions to supply demands for goods which are pouring in from all parts of the world. Nor is it a question merely of executing orders for staple goods or for goods which have always been produced here. Since the war many new lines of manufacture have been entered upon with excellent results to the enterprising capitalist. I heard the other day of a case in which a young engineer officer just demobilised backed by a Jewish capitalist set up a manufactory of aluminium goods. He knew nothing of this

branch of industry before but he applied his scientific knowledge to the work witb such good effect that he is now the director of a thriving concern producing a multiplicity of goods which have a ready sale. He is sending out travellers to South America and the East and there is every prospect that what originally was a very small concern will some day not very distant be a business employing thousands of men. Here is an example which the enterprising young Indian of scientific training might profitably copy. Aluminium goods are peculiarly adapted to Indian conditions and there should be an immense sale in the bazaars to those who cannot afford the more costly copper utensils which are traditionally favoured. It is in exploiting new ventures of this character that personal success is most effectively secured and it is also in this direction that India's industrial prosperity will be attained.

There has been quite an epidemic of burglaries here in the past few months due to the general unsettlement of the times and the release from the army of a number of bad characters who found temporary respite from professional thieving in military duty. The circumstance appears to have suggested to manufacturers of safes the desirability of putting upon the market some production which should be more burglar proof than the ordinary class of safe hitherto manufactured. A Bermingham house which specialises in this line has just turned out a safe which it is thought will prove too hard a nut to crack to even the most skilful cracksman. In the traditional safe the main reliance is placed upon the locking mechanism. Experience, however, has shown that there are no locks which cannot be picked or at all events forced. In the up-to-date safe mentioned a second line of defence is organized. This consists of the placing round the inside of the door of a series of bolts which are automatically engaged when the safe is shut and which can only be disengaged by operating the lock. If the lock is destroyed the opening of the safe is a difficult business even to the man who has designed the locking mechanism, to others it is an impossible feat. Truly the resources of civilization are not exhausted. It has to be seen, however, whether the last word has really been said in this contest with the powers of darkness.

British dyes have established themselves on a firm footing, thanks to the opportunity which the war afforded. But that the system that has been set up with the aid of Government capital is still far from complete and satisfactory is revealed in a statement which has just been circulated on the authority of the Manchester Chamber of Commerce. The Chamber takes exception to the present Government policy of subidising the dye industry without any effective guarantees as to the class of dyes produced on the ground that it has the effect of stereotyping the industry on lines which are disadvantageous to the users of dyes. It is complained that the dye industry as established concentrates on special classes of dyes which are readily produced to the exclusion of finer tone's which are not so marketable. So much is this the case that it is asserted that there are thousands of dyes made in Germany which are not produced at all in this country. The Manchester Chamber of Commerce outline certain safeguards which they propose to overcome this deficiency. They suggest that as a native dye industry is essential for the purposes of national defence the Government should specify the amount of plant which is essential to secure safety and should bear a share of the cost of keeping that plant in commission. Apart from this they consider that there should be no State support given to the industry and that there should be perfect freedom accorded to the colour users to secure essential dyes from abroad. The views set out in the Chamber's pronouncement are in strict harmony with the traditional free trade principles of Lancashire, but whether they will find acceptance in the rest of the country is a moot point. It certainly seems rather early days to talk of scrapping the machinery for the protection of this most important big industry which was set up with deliberate intention never again to be dependent on German or foreign sources for indispensable dyes.

ARNOLD WRIGHT.

INDUSTRIAL NOTES FROM THE UNITED STATES.

America Serving the World with Automobiles.

Washington, D. C., U. S. A., January 20th, 1920.—The recent assertion that three-fourths of the automobiles of the world are owned in the United States, and that nine-tenths of those now in the whole world were produced in American manufacturing establishments, lends interest to a compilation just available showing our exportation of automobiles from the earliest date to the present moment.

These figures show that the exports of automobiles and parts, including tires and engines, have in the past twenty years totalled about $ 1,000,000,000. The year 1919 has far surpassed all records.

The value of automobiles and parts exported in 1919 aggregated approximately $ 185,000,000 as against $ 140,000,000 in 1916, the former high record; $38,000,000 in 1914, all of which immediately preceded the war; $11,000,000 in 1910; $ 2,500,000 in 1905; and $ 1,000,000 in 1902.

Of the $ 185,000,000 worth of automobiles and parts exported in 1919, $ 35,000,000 were commercial cars, $ 75,000,000 passenger, $41,000,000 parts of automobiles, $30,000,000 tires, and about $ 5,000,000 worth of engines.

France, formerly a large manufacturer of automobiles, is showing a remarkable appreciation of the American commercial machine, the total number of these sent to that country in 1919 having been 3,600, valued at over $ 15,000,000. Great Britain, which took large numbers of American commercial machines during the war period, is now apparently manufacturing them for herself, for the total value of American-made commercial machines sent to that country has fallen from $ 20,000,000 in 1917, and nearly $ 7,000,000 in 1918, to only about $ 500,000 in 1919.

Sixty countries and colonies took American commercial machines in 1918, and the number of countries taking passenger machines was eighty. Iceland, in 1918, imported forty American passenger machines at a value of $35,000,000, and one commercial machine worth $2,400.

The imports of automobiles into the United States, which have aggregated $31,000,000 since the first record in 1906, have declined from the high water mark of $3,838,000 in 1910 to $524,709 in 1919.

THE ROMANCE OF COTTON.

Cotton is the fabric of civilization. It has built up peoples, and it has riven them apart. It has brought to the world vast and permanent wealth. It has enlisted the vision of statesmen, the genius of inventors, the courage of pioneers, the forcefulness of manufacturers, the initiative of merchants and shipbuilders, and the patient toil of many millions.

An extensive library could be written on the economic aspects of cotton alone. It could be told in detail how and why the domination of its field of manufacture passed to Spain, to Holland, and finally to England, which country now shares it chiefly with the United States. The interdependence of nations which it has brought about has been the subject of numerous books and articles.

Nor is the history of the inventions which have made possible today's great production of cotton fabrics less impressive. From the unnamed Hindu genius of pre-Alexandrian days, through Arkwright and Eli Whitney, down to Jacquard and Northrop, the tale of cotton manufacture is a series of romances and tragedies, any one of which would be a story well worth telling in detail. Yet here is a work that is by no means finished. Great inventors who will apply their genius to the improvement of cotton growing and manufacture are still to be born.

The writer's present purpose, however, is to explain a few phases of the growth of the cotton industry of the United States, in its more important branches, and to indicate its position in relation to the cotton industries of the remainder of the world.

For the present and for the future, as far as that may be seen, the United States will have to continue to supply the greater part of the world's raw cotton. Staples of unusual length and strength have been grown in some foreign countries, and short and inferior fibres have come from still others. But the cotton belt of the southern United States, producing millions of bales, is the chief source of supply for all the world.

The following table gives the comparative production of the great cotton-growing areas for the 1914-1915 seasons;—

United States	...	16,500,000 bales
India	...	5,000,000 bales
Egypt	...	1,300,000 bales
Russia	...	1,300,000 bales
China	...	4,000,000 bales
Other countries	...	1,300,000 bales
Total	...	29,400,000 bales (500 lbs, each).

The American crop is thus approximately 56 per cent of the world's total. The other producing countries have shown since the beginning of the century an interesting, if not a remarkable, growth, that of China being the largest in quantity and that of Russia the largest in proportion. The American increase has been larger, absolutely, than that of any other region, and there is little indication that it will not continue to hold first position.

In the manufacture of cotton Great Britain's supremacy, while not so great proportionately as that of America in growing it, is for the present not likely to be challenged. The following table of the number of spindles in the chief manufacturing countries is based on English figures compiled shortly before the outbreak of the world war. The number of spindles is the usual basis upon which the size of the industry is judged. It is not a perfect method, but it has fewer objections than any other:

Great Britain	...	... 55,576,108
United States	...	... 30,579,000
Germany	...	... 10,920,426
Russia	...	... 8,950,000
France	...	... 7,400,000
India	...	... 6,400,000
Austria	...	... 4,864,453
Italy	...	... 4,580,000
Latin America	...	... 3,100,000
Japan	...	... 2,250,000
Spain	...	... 2,200,000
Belgium	...	... 1,468,838
Switzerland	...	... 1,398,062
Scattering	...	... 2,499,421
Total spindles		... 142,186,308

Such figures can only be approximate. The war has brought growth in the United States and Japan, but has certainly reduced the number of spindles in Germany, Austria and Russia. It is very doubtful, moreover, how well the French industry has been able to maintain itself. But the tabulation is accurate enough to show the relative standing of the various countries. There are, as has been indicated, other standards than the number of spindles. The United States, through the fact that it specializes, generally speaking, on the coarser fabrics, uses about 5,000,000 bales of cotton annually, as compared with Great Britain's 4,000,000. The British product, however, sells for much more. Thus the value of the spindle standard is affirmed. England, then, produces well in excess of one-third of the cotton cloth of the world, the United States considerably more than one-fifth of it, with the other countries trailing considerably behind, but prospering nevertheless.

New Use for Jack Screws.

After the immense new "intake crib" at Chicago, Illinois, had been completed it was found that the stone superstructure was over eighteen inches out of plumb. This was a

bad situation. The ring-shaped superstructure, built of large, square-hewn blocks of granite, has an outside diameter of seventy feet at the top and ninety feet at the bottom, with an inner diameter of forty feet.

The superstructure rests upon a double-walled steel caisson filled with concrete, which was sunk to the bottom of Lake Michigan to form the foundation of the crib. The uneven density of the clay bottom caused the caisson with its superstructure—which alone weighs about 1,500 tons—to lean over.

In order to bring both the superstructure and its foundation back to a vertical position was not feasible because the foundation did not rest upon bed rock. It was decided, however, to tilt the superstructure to a vertical position. This was done, not by rebuilding the ring of stone masonry, but by blasting away the layer of concrete by which the superstructure was joined to the foundation, placing a large number of jack screws between the foundation and the ring of masonry, and by means of these raising the superstructure on the overhanging side and lowering it on the opposite side until the whole structure was again in plumb.

The concrete was blasted out by small charges of dynamite handled so skilfully that the masonry above was not hurt in the slightest degree.

To keep the waves from dashing in where the concrete had been removed, plant shutters, suspended by ropes, were placed over the open spaces. For leveling the superstructure over 300 jacks were used, which were manned by twelve experienced house movers. Masonry underpinning was substituted for the jacks when the superstructure has been tilted to a vertical position.

How Fast will Sound Travel?

The speed with which sound travels through space depends in some measure on the temperature of the medium through which the sound waves pass. But what is the exact relation ?

A professor in the University of Illinois has just given the results of his investigations into this interesting subject. The experiments were conducted with an ingeniously arranged apparatus including a Helmholtz siren driven by a small electric motor. The pitch of the sound produced by the siren is indicated by a counter connected with the siren.

A spool-shaped apparatus supported by a stand is the resonator, and is of the type invented by Rayleigh. It consists of two concentric metal tubes of different diameter. A small cylinder which is placed inside the larger is encircled by a heating coil. By sending an electric current through the resistance coil the inner tube may be heated to a high temperature, and the temperature may be maintained indefinitely.

Now, the pitch of the inner tube at normal temperature is known. From the inner tube, at a point two-thirds of the distance from the open end, a vertical tube of small diameter extends upwards through the outer tube. Within that vertical tube a fine thread is suspended to which two small circular disks are attached—one just within the horizontal tube, at the end of the thread, and the other higher up, outside of the larger tube.

It is found that the lower disk will respond by rotating to siren sounds having approximately the same pitch as the resonator, while the higher disk will show a maximum deflection when the pitch of the siren is sufficiently raised to correspond with the pitch of the resonator at the higher temperature.

By plotting the observations made at different temperatures on the chart, lines were obtained which established a fixed ratio between the square of the pitch and the absolute temperature. This ratio was maintained only for temperatures up to 400

degrees Celsius. In the experiments the temperature of the inner tube was regulated by a thermostat.

THE NERVE CENTER OF THE AIRPLANE.

Now that airplanes are coming rapidly into commercial use it is well to become as familiar as possible with the general principles of their operation. What must the pilot know about his airplane during flight? He must know the direction and velocity of the wind, the altitude, direction and speed of his flight, the position relatively to the horizon of the airplane in space, the cylinder pressure and performance of the engine or engines, the quantity of fuel in the tank, and the temperature of the cooling water.

The pilot must ascertain at a glance what is necessary for him to know, and instantly control the engine, ailerons and rudder. Since he is strapped to his seat means of obtaining this information and controlling the airplane must be centralized within reach of his eyes, hands and feet.

In all modern airplanes the various instruments and indicators, as well as the controlling switches, are located on the dash-board. In some of the larger airplanes some of the instruments are duplicated, because these machines are intended for two pilots sitting side-by-side and alternating in the control of the flight.

In the middle of the dash-board is the altitude indicator, reading to 2,800 meters (about 8,500 feet), the greatest height attainable by this type of machine. In front of each pilot is an air-speed dial, which indicates the speed with which the supporting air current strikes the controlling surfaces of the airplane. For each of the four engines there is a separate dial indicating the number of revolutions up to 2,200 a minute, and another dial showing the temperature of the cooling water. Near the lower edge of the dash-board, between the two pilots, is the position indicator.

Among the control switches on the dash-board are those for lighting the various dials and instruments, for electrical light and sound signals, for navigation lights, and for turning on and off the current in the electrically heated garments of the pilots when they are exposed to the intense cold of the higher altitudes. There is also a clock, a two-buttou switch for the landing lights near the altimeter, and two switches for the radio apparatus.

SAFEGUARDING THE ROLL-FILM EXPOSURES.

There have been so many inventions of late bearing upon the preventions of double exposures on roll-film that it seems but a short time before some make of camera will incorporate this feature. Such a device is absolutely necessary in most cases, because one of the most frequent mistakes made by the amateur photographer is to forget to turn the film, thereby making a second exposure on the first. There are a number of these inventions, most of them taking the form of a locking device engaging with the film-winding in such a manner that when the first exposure is made the shutter is locked. To make another exposure the operator must turn the film key, thus bringing a fresh section of the film into position and unlocking the shutter. Others merely indicate that the exposure has been made, and it is necessary for the operator to wind the film and then reset the indicator.

ALFRED T. MARKS.

NOTES.

The *Board of Trade Journal* publishes the following particulars relative to the present position of the Sugar Industry in France:—Of the 206 sugar factories which were in operation in France during the years 1913-14, 72 were totally destroyed and 59 put out of action under the German occupation. According to the "Journal des Contributions Indirectes" 28 factories of the Somme and 26 factories of the Aisne were razed to the ground, while factories in the Nord were more or less pillaged, and the plant taken away.' At the commencement of the 1919 sugar season only 60 factories were able to undertake work in these areas. The reduction in production has thus been quite appreciable. Production for the season preceding the war was about 717,228,946 kilogrammes (1 kilo = 2'2046 pounds). The estimates for the present season are actually about 150,000,000 kilos. It is true that there is a Colonies production, but unfortunately the Colonial which were formerly able to supply about 100,000,000 kilogrammes have been obliged to reduce their export, not only because of the difficulties of freight, but also on account of the high prices of alcohol, due to the State control over that industry, which have induced the French Colonies to produce more rum, to the detriment of sugar. During the last season imports from the Colonies fell to 54,000,000 kilogrammes. The rise in prices and compulsory restrictions naturally reduced the consumption, but nevertheless it became necessary to draw on foreign production. In 1918-19, foreign imported sugar amounted to 367,000,000 kilogrammes, of which 150,000,000 came from the United States, 101,000,000 from Cuba, and 38,000,000 from the Dutch East Indies. In order to re-establish the industry it has been suggested that the number of factories should be reduced, and the average production of the remaining factories should be increased, in order to diminish costs, and for this purpose it would be necessary to place the factories in those areas where the best conditions prevail for supplies of beetroot and alcohol. It is considered, however, that German competition must be faced eventually. In Germany the whole of the beetroot crops is reserved for the sugar industry, whereas in France manufacturers of sugar and distillers compete for crops, prices of which gradually increase. In Germany, distillers are supplied exclusively by potatoes and grain. The French State monopoly of the alcohol industry will involve competition between the Minister of Finance and the sugar producers, and in order to secure an adequate supply of alcohol the price to be offered by the State will have to be sufficiently remunerative. The price of industrial and other alcohol in France will consequently fix the price of sugar. According to official statistics the area under sugar beet fell from 249,349 hectares (one hectary = 2'47 acres) in 1913 to 76,720 hectares in 1917.

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A company has been formed in Japan with a capital of yen 2,000,000 to manufacture pulp from seaweed. Its prospectus states that the quantity of pulp annually consumed in the country as material for making paper is nearly 300,000 tons, including what is produced in Japan and importations. Paper mulberry (mitsumata), hemp, rice straw, etc., are used in Japan as material for paper. Of late, however, wood pulp represents 70 or 80 per cent of the total quantity of material used. Wood pulp is actively produced in the Hokkaido and Karafuto, but as the wood, when felled, is not restored to its old condition until several dozen years have elapsed, it is considered by this company that the wood available for the making of pulp will get more scarce as time goes on. The company has a patented

process of manufacturing pulp out of seaweed of the name of "ajimo," of which there is an inexhaustible supply around the coast. Its growing power is said to be so great that four or five months after being cut off it is found to be ready for another gathering. In addition to its power of rapid growth, another convenient feature of this weed is that it grows collectively, and its great vitality prevents other weeds from growing near the place where it is found, thus making the process of gathering easy and convenient. The company compares the cost of production with the cost of wood pulp, as under:—

	Sen.
Cost of production of sulphite wood pulp (Hokkaido)	10·4
Cost of production of crushed wood pulp in Japan proper (used as material for paper for newspapers, etc.)	6·5
Cost of production of "ajimo" pulp (material for Japanese paper and superior European-style paper) ...	4·8
Average market price of native pulp (produced in Karafuto) ...	14·5
Average market price of imported pulp	20·0
Probably sale price of "ajimo" pulp.	8·5

The objects of the company are given as:-

(1) The manufacture and sale of pulp.

(2) The manufacture and sale of paper.

(3) The manufacture and sale of machine for making paper or machines for making material for paper.

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In the *Revue D'Economic Politique*, for November—December 1919, of which we have received a copy through the courtesy of its founders, Professors Charles Gide, Alfred Jourdan and Edmond Villey, the well-known French economists, the position of France in connection with the Treaty of Peace is dealt with under six different heads. The financial clauses are commented on by Mr Henri Truchy, the Economic clauses by M. F. Sauvaire-Tourdan, the labour clauses by Mr. Octave Festy, the Colonial clauses by Mr. Arthur Girault and the African clauses by Professor Charles Gide. The French Financial situation gets further attention at the heads of M. Georges Lachapelle. Altogether this number of the *Revue* may be termed the Treaty of Peace number Needless to add the articles are full of suggestive remarks and shrewd observations, which ought not to surprize any body when the position and status of the writers in the economic world is remembered.

We note some further correspondence on the subject of sugar production in India. In the *Tropical Life* for February, Dr. C. A. Barber answers Mr. H. H. Smith's letter in that journal. Dr. Barber refers to Mr. Subba Aiyyar's article in this *Journal* and says that he is "in cordial agreement with his gentleman." All the same Dr. Barber reiterates his opinion "that there is not immediate prospect of India's contributing to the world's sugar supply, if indeed she succeeds in producing enough for her own needs." Every one would do well to await the Report of the Indian Sugar Committee in this and other matters relating to the possibilities of increasing sugar production in India.

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Prospects are entertained that the American candy or confectionary trade will show rapid growth with the disappearance of the liquor trade. A study of the working conditions in candy-making, issued by the Director of the Women's Bureau of the United States Department of Labour, shows the weekly earnings of girls in candy factories in Philadelphia. The total output of candy in the United States, according to the last census (1914) was valued at 170,000,000 dols., of which the total pay roll amounted to 25,500,000 dols. for 53,558 wage earners employed in 2,391 factories. Every State

in the Union has at least one confectionery establishment, the Women's Bureau states, but the largest number of wage-earners are employed in the manufacturing States of New York, Massachusetts, Pennsylvania, and Illinois. In Philadelphia the factories employ 3,415 candy-makers. An average of a little over 400 dols. per year, the report shows was paid to candy workers in 1914. In 1919 the average rate in Philadelphia was not quite 450 dols. per year. The outstanding features of the candy trade from the workers viewpoint are, according to the report of the Women's Bureau :—

Very low wages.
A dull season of four months when only about one-half of the employees are at work.
Most of the workers are women.
Most of them American born.
Most of them young.
Most of them contribute to the support of others.
Unsatisfactory and inadequate sanitary provisions.
High labour turnover.

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According to the Colonial Report on British Guiana for the year 1918 the sugar crop of the Colony was a little below the average, being 107,539 tons, as compared with 108,422 tons, the average annual yield of the preceding seven years. Owing to freight difficulties only 93,001 tons were exported during 1918. The returns submitted by sugar-estates in the Colony show that in 1918 more than nine-tenths of the total area —73,565 acres—under sugar-cane was planted in varieties other than the Bourbon. Only 3,500 acres are now occupied by Bourbon unmixed with other varieties. Of the area, estimated at 69,000 acres, cultivated in new varieties, 92 per cent was under canes raised from seed in this Colony, while about 7½ per cent was occupied by varieties imported from Barbados. Of the total area in cane cultivation, 78 per cent is occupied by new varieties raised at the George town Botanic Gardens. According to the same Report coconuts were planted on 29,400 acres of land, whilst the acreage in 1919 was 23,900. The export of nuts decreased from 1,911,000 to 1,516,000 but in addtion 2,487 cwts. of copra and 20,650 gallons of oil were exported. By far the greater number of the nuts grown returned by the growers at 14,217,000, were used locally for the manufacture of oil or directly as food. There is still a very wide area of land suitable for the planting of coconuts, on parts of which extension of such planting is being actively carried on. Under proper cultivation and drainage the yearly crop will be very largely increased in the near future.

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It is generally assumed in the German Press that apart from the danger of an "economic war" on Germany, there is also what is termed a "psychological epidemic" with which entire nations are afflicted. This is resolving itself into an aversion for everything German, which will continue for some time to lead to a situation in all economic life similar to a state of war. To overcome this prejudice many suggestions have been made, some of which have been carried out. The first was the idea of selling German merchandise under the trade-marks of neutral countries. This, it is stated, has necessarily been abandoned. Another project is the establishment of branch factories in neutral countries. But here again, Switzerland, for example, has taken measures to prevent articles produced by such branch plants from bearing marks indicating Swiss manufacture. Such articles are not admitted to the Sample Fair at Basle, and it is anticipated that there will be future legislation, at least in France and England, to prevent the entrance of these pseudo Swiss products. It is hoped, however, that it may be possible to overcome these difficulties by founding in neutral countries local (national) firms under the control of dummy directors. For the

period immediately following the war, at least, it is urged that everything points to the neutral as the proper representative of German firms. He can enter France and England without difficulty, and can sell his customers German goods, which naturally speak for themselves.

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Exhibitions in connection with the fifth British Industries Fair were opened at the Crystal Palace and in Glasgow and Birmingham on February 23rd. The classes of goods on view at the Crystal Palace, where the stalls extend to five miles and cover an area of twenty acres, include cutlery, silver and electro-plate, jewellery, clocks and watches, glassware, china, earthenware, paper, stationery, printing, fancy leather goods, brushes, toys, sports goods, scientific instruments, optical and photographic goods, drugs and druggists' sundries, musical instruments, furniture, and art needlework requisites. The exhibits in Birmingham consist largely of machinery, metalware, hardware goods, and household utensils. Features at Glasgow are clothing, general textiles, foodstuffs, and chemicals. Admission is restricted to business men, of whom 150,000 were invited. The *Board of Trade Journal* mentions that the Fair has been well attended from the opening, not only by British trade buyers but by overseas representatives, including buyers from South Africa, Netherland East Indies, the United States, Finland, and on behalf of the Esthonian Government, as well as from European allied and neutra countries. It is announced that four travelling exhibitions of British goods are to be established for the Overseas Dominions, the Far East, the United States and South America. In addition, the opening of showrooms on the Continent and elsewhere for the display of British productions is under consideration by the Government.

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There are rumours of the probable early appointment of a permanent Trade Commissioner in India by the United States Government, although so far the American Consulate in Calcutta is without definite news on the subject. In this connection, however, it is of interest to observe that Mr. W. H. Rastall is now visiting India as a Special Trade Commissioner of the United States Government to investigate the prospects for the extension of the sale of American machinery. Mr. Rastall is a mechanical engineer, who during the war was in charge, in Washington, of the aircraft productions of two of the American States, and he was despatched on this special mission to the East just before the Armistice was signed. He came to India *via* Java and the Straits Settlements, and proposes to stay four months, then proceeding to China and the Far East. Up to the present, with the exception of the American Consular Officers in Calcutta and Bombay, virtually no commercial work has been conducted on behalf of the United States Government in India, but this mission and the probability of the appointment of a permanent Trade Commissioner would seem to indicate a determination to foster trade officially, and to presage still keener American competition in the Indian markets.

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As a result of the recommendations in the Indian Industries Commission interim report, the general orders regarding terms and conditions on which Ceylon Government Agents may allow grants of Crown land to plumbago prospectors have been amended and revised. Hitherto lands were put up for public auction. In future they will be granted on payment of a royalty per ton, and facilities will be given to lessees to get into possession of the land promptly. The procedure to be adopted is: When a prospector believes a certain piece of land to contain plumbago the Revenue Officer will be authorised to allow him to have the boundaries of the land which he applies for to be permanently defined and marked on a

plan to be handed to the Revenue Officer. and the Inspector of Mines are to determine the value of the land. The Revenue Officer is then authorised to accept the first annual payment and allow mining operations to begin. In the event of the potential value of the plumbago deposits being difficult to be ascertained the lessee may be called upon to pay royalty on plumbago removed. The leases are to be taken for periods of 15 years and not for 5 years as was the case before.

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A Resolution of the Government of India in the Finance Department, dated the 15th March, 1920, says:—In consequence of the acceptance of the recommendation of the Indian Exchange and Currency Committee that the exchange value of the rupee should be fixed at one-tenth of the gold content of a sovereign, the Government of India have, with the approval of the Secretary of State for India, decided that the rate of Rs. 10 to the £ shall be adopted for the conversion of sterling transactions into rupees and *vice versa* in all Government accounts and statistics with effect from the 1st April, 1920. The Budget estimates for the year 1920-21 have been prepared on the basis of the 15-rupee rate, but they will be recast on the new basis as soon as possible after the first April. The new rate of Rs. 10 to the £ will also be applied to the expression "sterling," as far as practicable, in all official documents and correspondence from the 1st April, 1920. Gold coin and bullion, however, will continue until further orders to be valued at Rs. 15 per £ in all Government accounts and returns inclusive of the accounts of the Paper Currency and Gold Standard Reserves.

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A Yokobama report on the cotton market states that Japanese spinners, having sold a head cotton yarns as far as October, 1920, or March, 1921, need a proportionately greater amount of raw cotton, and are said to have purchased American cotton of some 70,000 bales at 29-30 cents. The total purchases of cotton by them since the new crop season are placed at 520,000 or 530,000 bales. Chinese cotton bought up to the present is put at 50,000 bales, and the new crop of Indian cotton purchased in the meantime at 400,000 bales. When these figures are put together, the total comes to some 1,000,000 bales, and when American cotton to the extent of 200,000 bales, Indian cotton of 400,000 bales, and Egyptian cotton of 20,000 bales are purchased in addition, the Japanese spinners will be supplied sufficiently for next year. Negotiations are going on for the buying of Egyptian cotton, and as the quotation is so high as about yen 150 delivered in Japan, no noteworthy business has been done as yet.

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Samples and photographs of a Danish invention, together with a report for impregnating cement, may be seen at the Enquiry Office of the Department of Overseas Trade, 73, Basinghall Street, E. C. 2. It is understood that the process is regarded as having established its claim to practical utility, and that besides the purchase of the rights by a well-known Danish company, the invention has already been taken up by a Norwegian company. Negotiations are also being carried on for the sale of the invention in Sweden, Holland, Germany, United States of America, the Argentine, and Mexico. The invention consists in the composition of a fluid in which the cement pipes are dipped, and it is claimed that the fluid thoroughly impregnates the pipes, which become thereby as serviceable for drainage and similar work as the glazed earthenware pipes generally used.

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What is regarded as the first commercial de-hydrating plant for wine grapes in the world is now in operation in Pomona, California. At the end of the first 24 hours it had handled ten tons of wine grapes, which would otherwise have been useless because, it is stated, of their over ripe and broken condition caused by recent rains. The owners of the plant assert that after fruit has passed through this de-hydrating process, it can be kept indefinitely, and when again placed in water the empty cells will refill and the grape or apricot, as the case may be, will be restored to its original condition.

GLEANINGS.

Briquettes are now being made from waste wood products, as sawdust and shavings. It is found that under pressure these materials can be briquetted without a lage percentage of binding material, but where this is used it is found that waste and spent grian from breweries can be used. The plant required consists of a drying apparatus, a press and baking oven, and about 16 h. p. is all that is required to work the presses. The briquettes are comparatively light, and are of the slow burning type, and their use is principally for keeping furnace fires alight during periods when little or no pressure of steam is required. It is said that about 10,000 kilogrammes of the briquettes are equal in heating power to about 6,000 kilogrammes of steam coal.

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The Supervisor of the Forest Service of Alaska declares that the territory has enough timber to furnish one-half the newsprint paper of the United States for an indefinite period, and that with proper care the industry could be made inexhaustible. This is of especial interest in view of the approaching disappearance of supplies in the Eastern forests, and financial interests have been already looking over the field. In the event of the project taking shape, and the removal by Congress of certain Government restrictions, which at present block the way of some mill plants, it is expected that American mills will be established at Ketchikan and Juneau, which it is hoped will equal the record of some mills across the Canadian border.

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A concession has been given by the French Government for the formation of a company to develop the cotton-growing industry in French West Africa. According to the Decree authorising this concession, published in the "Journal Officiel" of 4th December, the company is to be constituted under French laws, with an initial capital of two million francs, this capital to be increased successively to ten and twenty million francs. The area marked for irrigation is 100,000 hectares in the basin of the Niger, exclusive of the areas drained by the tributaries of lakes Horo, Fati, Tele, Faguibinu, and Daounas. British firms requiring further information on the terms of the concession should apply to the Department of Overseas Trade.

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The recent success of the aerial mail trials between Tokio and Osaka has demonstrated to the Japanese Government the possibilities of civil aviation, while the advances made in international aviation in other parts of the world, coupled with the probability of Japan being involved at no distant date in questions of aerial jurisprudence, have roused the Cabinet to the realization of the immediate necessity of providing machinery competent to deal with the new developments. A Special Committee therefore has been instituted as a temporary measure pending the approval in the Budget Estimates of the creation of a permanent "Aviation Board." It is expected that the latter will be established by April, 1920.

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The Johannesburg Town Council, having given the site for a University, has granted £10,000 per annum towards its maintenance. The object of the institution will be to provide education of a scientific, technological, and commercial character best directed towards the industrial and commercial development of the resources of the Union. The Union Government is to be asked to increase its contribution of £26,000. The Chamber of Mines and the Rand municipalities support the scheme. The erection of the Medical College has been started, and already there are 31 departments at the School of Mines.

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"The excess of American exports over imports has grown out of bounds," in the opinion of Philip B. Kennedy, whose first annual report as Director of the Bureau of Foreign and Domestic Commerce, Department of Commerce, was published recently.

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A Swiss cycle merchant who bought a number of German bicycles recently, states that he will buy no more, as the cycles break the pieces.

ECONOMIC NOTES.

INDUSTRIES AND COMMERCE.

Manufacture of Packing Paper from Spent Wattle Bark and Wood Chips.

We publish below (1) the Interim Report by the Imperial Institute, London, in December, 1917, on the use of spent wattle bark and wattle wood as paper-making materials, and (2) the Report of the Chemical Waste Products Committee of the British Munitions Inventions Department, dated February, 1919, on the utilization of wood chips for the manufacture of packing paper with additional information on the utilization of mimosa bark :—

I.

Interim Report by the Imperial Institute on the use of Spent wattle bark and wattle wood as paper making materials.

SPENT WATTLE BARK.

An investigation has been conducted at the Imperial Institute in order to determine the value as a paper-making material of spent wattle bark, *i.e.*, the residual bark after use by tanners or tanning-extract manufacturers. A sample of the material was submitted to preliminary tests in the Scientific and Technical Department of the Imperial Institute and subsequently large scale trials were made by paper manufacturers. The results so far obtained are of very promising character and are summarised in the following statement.

The material as received at the Imperial Institute was found to contain 11·5 per cent of moisture, 41·2 per cent of cellulose, and 8·7 per cent of ash. On extraction with hot water the bark lost 7·0 per cent by weight.

The ultimate fibres of the material measured from 1·0 to 2·2 mm. and were mostly about 1·7 mm. in length.

The spent bark was converted into pulp by the soda process with the following results :—

Experiment No.	Caustic soda used		Conditions of boiling		Parts of Soda consumed by 100 parts of bark	Yield of dry unbleached paper pulp expressed on the material as received (per cent)
	Parts per 100 parts of bark	Parts per 100 parts of solution	Time in hours	Temparature		
1	20	4	4½	140°C	14	28
2	16	4	4	140°C	14	34
3	12	4	4	140°C	all consumed	35

When treated under the conditions of experiment 2, the bark was sufficiently boiled to beat easily, and gave a dark brown pulp which yielded a fairly soft, opaque paper, of fair strength and quality, which did not shrink appreciably on drying. The pulp bleached readily but only to a cream colour.

The pulp from experiment 3 was not sufficiently boiled, and the fibres were not completely separated even after long beating. Such long-fibres pulp has been recommended as a material for the production of roofing felt.

The treatment used in experiment 2, therefore, appeared to be the most suitable for the preparation of "*half-stuff*" from the bark.

Although the yield of unbleached pulp from the bark is somewhat low, the material is fairly promising as a source of pulp for the production of brown paper and may be suitable for the cheaper grades of white or cream papers such as newspaper.

As large quantities of spent wattle bark were becoming available in the United Kingdom owing to the increasing use of wattle bark by British tanners, it appeared desirable to have large scale trials made with the material by paper-makers.

Three tons of the spent bark were therefore obtained from a firm of tanners and submitted to paper manufacturers for technical trials. The manufacturers reported that the dry bark furnished from 28 to 30 per cent of pulp, which would be quite suitable for the manufacture of brown paper.

The paper made entirely from the wattle bark under manufacturing conditions was regarded by the manufacturers as a very satisfactory wrapping paper of good strength and excellent folding qualities.

In view of the present high price of brown paper the current value to the United Kingdom of the spent bark, containing not more than 10 per cent of water, would be about £4 per ton delivered at a mill, but in normal times it would not be worth more than 30*s*. per ton. Arrangements are now being made by makers of brown paper in the United Kingdom to utilise the supplies of the spent bark which are becoming available from the tanneries.

Further enquiries are also being made by the Imperial Institute as to the possibility of utilising the pulp, after bleaching, for the production of cheap grades of cream or white paper, but this point is not yet definitely established.

WATTLE WOOD.

It seemed possible that the wattle wood obtained in the production of the bark might also be utilised for paper-making and trials have accordingly been made at the Imperial Institute.

A sample of black wattle wood was found to yield 61·0 per cent of cellulose and 0·5 per cent of ash, expressed on the dry material. The ultimate fibres measured from 0·8 to 1·1 mm. in length. The wood was converted into pulp by the soda process with the following results :—

	Caustic soda used		Conditions of boiling		Soda consumption per cent	Yield of dry unbleached pulp expressed on the wood as received per cent.
	Parts per 100 parts of bark	Parts per 100 parts of solution	Time	Temparature		
A	16	4	4 hrs.	140°C	11	46
B	14	4	7 hrs.	140°C	10	50

The wood yielded a clean pulp of light brown colour, giving an opaque paper which did not shrink on drying but was lacking in strength, owing to the shortness of the ultimate fibres.

The conditions employed in experiment A produced a pulp of lighter colour than that obtained in experiment B. The pulp did not bleach well in either case, but that from experiment A bleached better than that from B.

With a view to ascertaining whether the sulphite process would give better results the wood was also treated by this method with the following results :—

Strength of sulphite liquor 100 parts contained the equivalent of		Conditions of boiling		Yield of dry unbleached pulp, expressed on the wood as received per cent
Lime (CaO)	Magnesia (MgO)	Time	Temperature	
0·7	0·3	7 hrs.	150°C	48

As is generally the case, this process produced a pulp of much lighter colour than the soda process. The unbleached pulp was a light greyish-brown and bleached easily to a creamy white tint. The paper produced was similar in strength to that obtained by the soda process.

A firm of paper manufacturers who were consulted by the Imperial Institute as to the possibility of utilising wattle wood in the paper-making industry expressed the opinion that it could be advantageously used for making "straw-board." They considered that a mixture of 50 per cent of wattle wood and 50 per cent of spent wattle bark should give a good "straw-board" which would probably find a ready market in South Africa for the packing of fruit and other purposes.

The foregoing results show that black wattle wood gives a very fair yield of pulp, but that owing to the shortness of the ultimate fibres the paper produced is of rather poor strength. It should however be possible to utilise the pulp, as suggested above, in connection with other materials of longer fibres, such as the pulp from spent wattle bark.

II.

Report of the Chemical Waste Products Committee of the Munitions Inventions Department on the utilization of wood chips for the manufacture of packing paper with additional information on the utilization of mimosa bark.

EXPERIMENTS WITH WOOD CHIPS, INCLUDING BARK.

As the erection of a soda or sulphate plant for the conversion of wood chips, including bark, into cellulose, is not a commercial proposition, the experiments with this material have been confined to processes which can be conveniently carried out in most of the paper mills manufacturing brown wrapping papers. High pressure boilers as a rule are not available in such mills, and the chips have therefore been boiled under a pressure not exceeding 45 lbs. per square inch. The most satisfactory paper as

regards strength and apparance was obtained by treatment of the material in the following manner :—

The air dry wood chips, including bark, were boiled with 22 per cent of caustic soda (strength of the boiling liquor 7°Tw.) during 12 hours, under steam pressure of from 40 to 45 lbs. per square inch, in a stationary boiled. The boiled chips were then washed and broken for 3 hours and beaten for 5½ hours. The total yield of paper was 49·3 per cent calculated on the air dry material; the yield is, therefore, a very satisfactory one. Tests made with this paper gave the following results :—

Thickness	·127 mm.
Bursting strain	36,000 lbs. per sq. inch.
Breaking strain (machine way)	6·2 kilograms
Breaking strain (cross way) ...	3·4 ,,
Elongation (machine way) ...	1·6 per cent.
Elongation (cross way) ...	5·0 per cent.
Folding resistance (machine way)	142·
Folding resistance (cross way).	132·
Weight of paper	82·51 grms. per. sq. metre.

Wood waste could most satisfactorily be dealt with, with a minimum outlay of capital, by working the necessary chopping machinery in the places where the wood waste is available. There should be no difficulty in finding paper manufacturers who would be willing to buy the chopped waste and to use it in conjunction with other paper-making raw materials in the manufacture of brown papers.

Satisfactory results should, for instance, be obtained by using this waste in conjunction with mimosa bark.

Experiments with Branches from different Woods from Scotland including young Birch and Oak.

The branches, with the bark, were chopped and mixed. The following treatment produced the most satisfactory paper :—

The chopped branches were boiled with 20 per cent of caustic soda (strength of the boiling liquor 8°Tw.) for 12 hours, under a steam pressure of from 40 to 45 lbs. per square inch. The boiled chips were then washed and broken for 2 hours, beaten for 4 hours and finally run on the machine. The stuff was very free and the yield of paper about 35 per cent calculated on the air dry logs. Tests made with the paper gave the following results :—

Thickness	·22 mm.
Bursting strain	33·2 lbs. per sq. inch.
Breaking ,, (machine way).	5 kilograms.
,, ,, (cross way) ...	3·3 ,,
Elongation (machine way) ...	3·4 per cent.
,, (cross way) ..	4·8 per cent.
Folding resistance (machine way)	62·
,, (cross way).	38·
Weight of paper	88·5 grms. per sq. metre.

Although the breaking strain is satisfactory, the resistance of the paper to folding is very low, *i.e.*, the paper is very brittle. This material, by itself, could not be recommended as a satisfactory paper-making raw material, but it should be possible to employ it as a suitable filler along with more fibrous materials. The brittleness of the material is no doubt due to the fact that it contains a much larger percentage of bark, as compared with the wood chips used in the other experiments.

Mimosa Bark.

The waste bark, as received from the tanner contains 75 per cent of water, *i.e.*, 100 lbs. of wet bark yields 25 lbs. of the air dry material. If, therefore, the waste bark has to be carried a considerable distance, the tanner should be advised to spread it out and air-dry it as far as possible. If the paper mill is within easy distance of the tannery drying would not only be unnecessary, but it would be preferable to send the bark to the mill in the wet state because the wet bark will more readily respond to the treatments in the paper mill than the dry bark. Numerous experiments in boiling the bark were carried out, but the following was found to give the most satisfactory results :—

The waste bark was boiled with 10 per cent of caustic soda, calculated on the dry weight of the bark, for 5 hours, under a steam pressure of from 20 to 25 lbs. per square inch, in a spherical revolving boiler. The pulp obtained was perfectly soft and of a dark brown colour. The boiled material was washed and broken for 1½ hours, care being taken to retain the brown colouring matter as far as possible. It was finally beaten for 4½ hours, and after a small quantity of resin and alum had been added, was converted into paper on the Fourdrinier Paper Making Machine. The total yield of paper calculated on the air-dry material was 38·5 per cent. Boiling of the wet bark in a stationary boiler in place of a revolving boiler may be suggested, and would probably give a somewhat higher yield.

Tests made on this paper gave the following results:—

Thickness	·214 mm.
Bursting strain	20·8 lbs. per sq. inch.
Breaking strain (machine way).	3·6 kilograms
,, ,, (cross way) ...	2·5 ,,
Elongation (machine way) ...	2·2 per cent.
,, (cross way) ...	2·18 ,,
Folding resistance (machine way)	26·
,, (cross way) ...	17·
Weight of paper	70·44 grms. per sq. metre.

In another experiment a quantity of waste bark was boiled; material was somewhat darker in colour than that produced by boiling with caustic soda. After boiling, the material was broken for 2 hours and beaten for 4½ hours. The total yield of paper was about the same at that obtained from the pulp boiled with caustic soda, but it should be pointed out that the pulp obtained by the lime boil does not run as well on the paper machine as that obtained by the soda boil. Test made with the paper from the lime boiled pulp gave the following results:—

Thickness	·375 mm.
Bursting strain	11·5 lbs. per sq. inch.
Breaking strain (machine way).	1·9 kilogarms.
,, (cross way) ...	1·4 ,,
Elongation (machine way) ...	·75 per cent.
,, (cross way) ...	·92 ,,
Folding resistance (machine way).	
,, (cross way) ...	
Weight of paper	144·5 grms. per sq. metre.

The figures show that the bark when boiled with lime produces a paper which is much inferior to that produced by boiling with caustic soda; it is very brittle, and the breaking strain is very low.

Whilst a fairly useful paper can be produced with the bark alone, much better results may be obtained if it is used in conjunction with other paper-making raw materials. In a further experiment, paper was made from mimosa bark, soda boiled 33 per cent, mimosa bark, lime boiled 25 per cent, waste paper 30 per cent and jute 12 per cent. The mixture was beaten for four hours, and was lightly sized with resin before running on the machine. This produced a very useful wrapping paper, tests of which gave the following results:—

Thickness	·277 mm.
Bursting strain	25 lb. per sq. in.
Breaking strain (machine way.)	5·67 kilograms.
,, (cross way) ...	3·0 ,,
Elongation (machine way) ...	1·65 per cent.
,, cross may ...	1·93 ,,
Folding resistance (machine way)	18
,, (cross way ...	17
Weight of paper	103·0 grms. per sq. metre.

Considering the results obtained with the soda boiled bark alone, it is, therefore, safe to assume that a good wrapping paper can be produced by using from 60 to 65 per cent of soda boiled bark with the addition of waste paper and jute as above, or with addition of jute only. Other raw materials employed in the manufacture of brown papers may however be usefully employed in conjunction with soda boiled mimosa bark.

COTTON-GROWING IN THE BRITISH EMPIRE.

It will be remembered that a Committee was appointed in July, 1917, by the President of the Board of Trade, London, "to investigate the best means of developing the growing of cotton within the Empire and to advise the Government as to the necessary measures to be taken for this purpose." The Report of the Committee has just been issued as a Parliamentary White Paper (Cmd. 523, 1*s*. 6*d*. net) and may be seen by vistors at the Commercial Library and Reading Room at No. 1, Council House Street, Calcutta. The Report is in two parts, Part I giving the general views of the Committee and setting forth their general plans and proposals for the development of the Empires' resources for cotton growing and Part II containing a detailed survey of the position both present and prospective in the various territories of the Empire, which

are considered suitable for the cultivation of cotton.

PAR II.

GENERAL CONCLUSIONS AND RECOMMENDATIONS.

The General Conclusions and Recommendations of the Committee are as follows:—

"In putting forward our conclusions and recommendations we have to admit that they are to a large extent provisional in their character. We are convinced that it is possible for the British Empire to make good the world's shortage of cotton, but the one conclusion that stands out plainly and definitely as the result of our work during the past two years is that this achievement is beyond the powers of this or indeed of any Committee. It can only be accomplished by the united efforts of the Imperial Government and the Governments of the cotton-growing Dominions, Colonies, and Protectorates, supported by the active interest and cordial co-operation of all who are engaged in the Cotton Industry in this country.

Our general recommendations are as follows :—

(1) That the Empire Cotton Growing Committee be authorised to continue its work on the general lines of the present Report, and that a grant be made to it by the Treasury of a sum of not less than £10,000 per annum for five years to pay for its secretarial and other current expenses and for any outlay that proves to be necessary for initiatory work in directions connected with the objects of the Committee.

(2) That the immediate importance of greatly enlarging and strengthening the Agricultural Departments of British Colonies and Protectorates be recognised as a preliminary step essential to any rapid progress, and that the Colonial office be respectfully recommended to appoint a committee to advise on the scale of numbers, salaries, and general expenditure which should be aimed at for adoption as and where circumstances permit.

(3) That, in order to supplement the present knowledge of scientific principles underlying cotton growing, a Central Research Institute be established as soon as possible for their investigation.

(4) That, in order to increase the supply and improve the training of scientific men, financial provision be made for at least four Readerships at British Universities in Plant Physiology, Plant Genetics, Mycology, and Entomology; that funds be provided for the awarding of Research Studentships to be held for one or for two years by graduates who are selected for training in methods of Research in this and other sciences concerned with study of the living plant; the number of these to be five to begin with, but to be gradually and considerably increased before long.

(5) That we should establish a Bureau for the interchange of knowledge of cotton growing and should arrange for the publication of a Quarterly Review devoted to this subject.

(6) That the Governments of all cotton-growing areas in the Empire be advised to take full powers for exercising strict control over all essential matters connected with cotton growing.

(7) That, where it is possible and seems desirable, such Governments be recommended to establish local Associations of cotton growers to advise their Government upon matters of general interest to the industry.

(8) That an agreement should be negotiated with the British Cotton Growing Association, in accordance with which that body will act as agent for the Empire Cotton Growing Committee for marketing crops where this is desired by the local Government; that it should be a condition of this agreement that the British Cotton Growing Association shall forego the appropriation of any profits made in the business carried on under the agreement, provided that the Association is guaranteed against permanent loss arising therefrom.

(9) Finance.—That funds for the promotion of cotton growing in the Empire should be provided from the following sources :—

(a) The British Treasury.

(b) The local revenues of cotton-growing areas.

(c) The Cotton Industry.

That the following general principles be accepted as a guide in discussion and in negotiations as to the allocation of financial responsibility to each of the above sources :—

(a) That the British Treasury may fairly be looked to—

(1) To provide for the secretarial and establishment charges of the Empire Cotton Growing Committee, and for outlay for

initiatory work in directions connected with the objects of the Committee.

(2) To contribute—in some proportion to be agreed—towards expenditure upon schemes approved by this Committee which have for their object the provision of the raw material upon which the great national industry of cotton manufacture depends.

(3) To assist the Governments of Colonies and Protectorates—either by grants or more probably by guarantees—to provide funds for public works, such as railways, waterways, irrigation and harbour works, necessary for the development of their resources.

(b) That where developments, although in their inception they may be connected with cotton growing, are calculated to extend the general prosperity of a Colony or Protectorate, they should as a rule be financed by the Colonial or protectorate Government.

(c) That where the growing of cotton is promoted in preference to other profitable crops, and where pioneer work is undertaken in order to ascertain whether cotton can be grown profitably, the consequential expenditure should be at the charge of the Cotton Industry.

(10) That the Committee be authorised to ascertain the opinion of the Cotton Trade of this country in regard to these recommendations, and in particular upon what lines effective co-operation in raising the necessary money may be expected from the organizations in which the trade is grouped."

PART II.

SURVEY OF THE COTTON GROWING AREAS OF THE EMPIRE.

The Summary of Special Conclusions and Recommendations is as follows :—

WEST INDIES.

"The crop, though small, is of world importance. We recommend that means should be provided to secure the continuance and, if possible, some enlargement of the Imperial Department of Agriculture. We also recommend that careful enquiry be made as to the best means of replacing the Sea Islands crop of the United States (which is in grave danger of practical extinction).

EGYPT.

(a) The Egyptian crop before the war had reached a total of over 7½ million kantars (or 1,875,000 bales of 400lb.). It has, however, during the war, fallen below 5 million kantars. Having in mind this fact and the particularly serious reduction in the supply of fine cotton generally owing to the loss of the Florida and Georgia (Sea Island) crop, we regard the position in Egypt with peculiar anxiety, and desire to emphasise the necessity of leaving no step untaken to remedy the causes which have led to this decline and to attain the maximum production of which the country is capable.

(b) As quality is of first importance in fine cottons, such as Egyptian, we consider it essential that work should be directed methodically and constantly, not only towards maintaining the quality of the existing, varieties but also towards securing and holding in reserve other varieties for introduction when and as expedient.

(c) We would specially emphasise the desirability of proceeding without delay with the measures already determined upon before the war to remedy the unsatisfactory condition of parts of the Delta as regards drainage and the control of excess water.

(d) Concurrently with the completion of these projects, it is of the utmost importance that water should be available for the reclamation and irrigation of the lands referred to as well as of those further north which will be restored to cultivation by the new drainage works. An adequate water-supply is available in the White Nile, and we trust that no time will be lost before adopting the best measures for its untilisation. Until this is done full advantage of the expenditure already incurred in the Northern Delta cannot be obtained.

(e) It is estimated that the measures referred to in paragraph *(d)* would result in an increase of 3,500,000 kantars of cotton, or about 900,000 bales of 400lb. The magnitude of such a possible increase in the Egyptian crop overshadows, though in no way detracts from, the importance of the prospective increase in Uganda or Nigeria, where some such figure as 100,000 bales may be expected as the result of development work.

(*f*) Since part of the serious reduction in the average yield of the crop is due to the devastation of the pink boll worm, we consider it essential that no time should be lost in putting into force the measures decided upon just before the outbreak of war to combat the ravages of this pest.

(*g*) We most cordially welcome the appointment of the new Cotton Research Board in Egypt and hope that every assistance will be given to it and to its endeavours to elucid to the problems affecting the Egyptian cotton crop, in particular, (*a*) the environment of the crop, specially with regard to water and to the control of insect pests, and (*b*) the maintenance and improvement of the quality of the seed.

SUDAN.

In our letters to the President of the Board of Trade dated 29th December, 1917, and 17th February 1919, we referred to the importance to Egypt of the Sudan irrigation and accompanying drainage schemes; and we desire to emphasise once more the fact that the irrigation projects in the Sudan form an inseparable part of the comprehensive scheme for utilising to the fullest extent the water supplied by the Nile.

We have heard very full evidence with regard to the Blue Nile Barrage, which would make possible the irrigation of some 300,000 acres of land as a first instalment in the Gezira, with prospects of a further increase to about 1,000,000 acres suitable for cotton growing. We are of opinion that the Gezira is one of the most promising districts for development that we have had to consider; we recognize, however, that, with regard to the utilisation of the Nile, the interests of Egypt have to be considered before those of the Sudan. At the same time we hope that the possibilities of opening up and developing the Tokar and Kassala areas may be carefully considered.

In the Sudan as elsewhere, we consider experimental work to be of the greatest importance. We are glad to be informed that this is fully recognized by those responsible for the Government of this important country.

MESPOTAMIA.

We are of opinion that the results obtained by the experimental work of the Department of Agriculture are very promising. These experiments, however, were necessarily carried out on a small scale. It is therefore most important that the work should be continued and extended in order to determine whether cotton can be economically produced on a commercial basis. It is essential for this purpose that arrangements should be made to build up a supply of approved seed for large sowings in 1921, and we have already recommended that the funds required to make this possible should be at once provided by a special grant.

UGANDA.

We recommend that the Agricultural Department should be enlarged, and that the salaries paid to its officers should be substantially increased, so as to retain those already employed, and to attract men of ability to the service.

Continued attention should be paid to the development of transport facilities, including improved waterways.

We recommend that Government control of the Cotton Industry already established should be maintained.

NYASLAND.

We wish to emphasise the necessity here, as elsewhere in Africa, of strengthening the Agricultural Departments and improving transport facilities.

RHODESIA.

We think it desirable that the possibilities of Rhodesia as a whole should be more fully explored, since, although none of the districts where pioneer work has been undertaken can be regarded as likely to produce a large cotton crop in the early future, they apparently possess possibilities for further development which may prove valuable later on.

The addition of cotton experts to the otherwise well-equipped Agricultural Department is essential before progress can be expected.

THE UNION OF SOUTH AFRICA.

The cotton-growing industry has now emerged from the experimental stage in South Africa. The results obtained indicate that cotton of excellent quality can be grown. We recommend that the valuable work done by the Department of Agriculture should be extended with the object of developing cotton-growing on a much larger scale.

NIGERIA.

We see reason for hope that great expansion may be possible in the growing of cotton in Nigeria, but before this can be attained a large increase in the staffs of the Agricultural Departments will be necessary. We have to reiterate once more the need for an increase in the salaries paid, if these Departments are to be maintained in an efficient state.

We are of opinion that progress equally depends upon the systematic development of the transport systems. Until main line railways can be constructed, we think that efforts should be made to open up the country by other means of transport. We understand that several methods have been tried, and we

would press the authorities to decide upon those most suited to local conditions.

We are of opinion that the work of the British Cotton Growing Association in promoting the commercial development of the cotton crop has been very valuable.

Meanwhile, we recommend that the British Cotton-Growing Association be asked to proceed energetically with its work in the areas in which it is now operating, with a view to increasing the cotton crop to the fullest extent of the capacity of the ginning and baling plant already installed, which appears sufficient to deal with a large increase upon the output of recent years. In this connection we recommend that our Committee should enter into a working agreement with the Association as outlined in Section 26 of this Report.

Exploratory work in new districts, for example in the region of Lake Chad, appears to us desirable, and we recommend that we should assist the local Government in pioneer work.

INDIA.

Following the recommendations of the Indian Cotton Committee, which sat in 1917-18, we advise :—

(*i*) That in order to obtain permanent improvements in cotton in India on a commercial scale, more detailed agricultural work, better methods of marketing and handling, and closer co-operation between the Agricultural Departments and the Cotton Trade interests should all be promoted.

(*ii*) That more detailed investigations of the existing kinds of plants in cotton-growing areas and more systematic tests of different varieties should be made. The work both of selection and plant breeding, should be conducted solely "by Research officers specially qualified therefor and able to devote their full attention to it." The methods of field tests should be systematised.

(*iii*) That special weight be given to (1) the importance of work directed towards the improvement of agricultural practice in its widest sense; (2) the need of staffing, organizing and equipping Agricultural Departments on a scale adequate to carry through widespread demonstration work; (3) the vital necessity of Government control in organizing the selection, supply and distribution of pure seed.

(*iv*) That the recommendations to appoint an additional mycologist and to discontinue work on perennial cottons be adopted.

(*v*) That the increase asked for in the staff of the Agricultural Departments, which is the minimum that can be expected to discharge the necessary duties assigned to these officers, should be granted.

(*vi*) That the possibilities of the Sukkar Barrage Project be re-examined.

(*vii*) That with a view to improving the marketing of cotton, market should be established under definite rules and regulations, and co-operative sale by the villagers should be encouraged.

(*viii*) That effect be given to the Indian Cotton Committee's suggestions for the licensing of ginneries and presses, and that the needful legislation be introduced. We also support their recommendation that the transport of cotton and waste be controlled.

(*ix*) That the proposal to form an East Indian Cotton Association be carried out, since we believe that the formation of an association on the lines indicated would be of benefit to the Indian Cotton Trade, and would be welcomed by similar organizations in other countries.

(*x*) That the standardisation of weights on the plan suggested—namely, 28 lb. (avoird.) to the maund, 28 maunds to the khandi—be adopted.

(*xi*) That the recommendations for improving crop forecasts be carried out, but that in the interest of accuracy the advisability of securing returns of unpressed cotton delivered direct to mills be considered.

(*xii*) That the proposal to form a central Cotton Committee, as outlined in the Report, be put into effect, and that the Empire Cotton Growing Committee work in co-operation with it wherever possible, in the interests of cotton production.

Finally, we would request sympathetic consideration for, and early action on, the various recommendations of the Indian Cotton Committee, which we consider well calculated, both to improve cotton-growing in India and to promote the material benefit of that country."

FIBRE RESOURCES OF INDIA.

The following is an extract from the report on the Progress of Agriculture in India for 1918-19:—

The conditions created by the war have necessitated a thorough investigation of the fibre resources of India. At present, India and specially Bengal, enjoys a practical monopoly of the world's supplies of jute. In profit to the cultivator and manufacturer, it is doubtful whether any other crop in India can successfully compete with jute, production being far short of the demand. There is, therefore, strong ground for advocating the extension of the cultivation of jute to other suitable localities, and a thorough investigation of the possibilities of growing more extensively other fibre plants also such as sunn-hemp, *Hibiscus cannabinus, Sida rhombifolia*, sisal hemp, flax, etc. Work on the improvement of fibre plants (other than cotton), which is in the hands of Mr. R. S. Finlow, has, up to the present, been practically limited to Bengal and Assam. The scope of this work has now been extended to other provinces also, but, his appointment to officiate as Director of Agriculture, Bengal, has prevented Mr. Finlow from entering upon this wider field of enquiry as yet.

JUTE.

Jute continued to be the chief item in the programme of the work of Mr. Finlow. It was stated in last year's report that there appeared to be a considerable variation in the resisting power to *chlorosis* on the part of various races of Jute. Two of the races continued to show the same immunity to this disease as they did last year. It would thus seem that immunity of plants to disease is hereditary in character. Non-chlorotic strains were almost invariably found to be more vigorous and taller than strains subject to *chlorosis*. In variety tests, one non-chlorotic selection (R. 85), a strain of Kakya Bombai (*C. capsularies*), yielded a much better crop than other strains of the race which were chlorotic, *viz.*, 2½ maunds more fibre per acre. About 35 tons of seed of R. 85 will be distributed in the coming season. The work is especially important as there appears to be a considerable danger of the spread of the disease.

Kakya Bombai continued to grow in popularity and the demand for its seed far outstripped the supply. About 55 tons of seed of this variety were distributed in the province in small quantities of ¼lb. for multiplication by the ryots themselves who are beginning to realize the necessity of growing their own seed of new varieties, especially because of the impossibility of getting seed supplied in bulk by the department. District reports speak of the excellent prices obtained by growers of this new variety, and the premiums obtained for it on account of its quality are probably due to its late flowering habit. The advantages of this habit were fully discussed in last year's report where it was stated that the general adoption of late flowering varieties would tend to improve the quality and yield of Jute. This view is now practically confirmed. The area under Kakya Bombai is increasing in the Jute tract of North Bhagalpur where about 200 maunds of seed were sold and the demand far exceeded the supply.

Kakya Bombai is not, however, the last word in jute selections. One or two other selections of Mr. Finlow promise to rival, if not to beat, Kakya Bombai. Hitherto none has done so excepting the non-chlorotic strain of Kakya Bombay, R. 85, referred to above.

In variety tests with pure lines of C. *olitorius*, R. 26 kept its place at the head of the previously tested races, while a new race (Chinsura green), included for the first time in the test, did extraordinarily well. About 5 tons of the seed of R. 26 were raised during the year for sale and distribution.

Manurial trials on the red soils have yielded more striking results in the year under review and have finally proved that, for jute, lime and potash are both limiting factors and that a normal crop cannot be grown on the red soil without the application of manures containing both of them. The results also serve incidentally to establish the value of hyacinth as a potash manure. The money expended on lime, bone and potash manures practically trebled the net revenue per acre, and in doing so yielded interest at approximately 100 per cent per annum. The results are now considered well established and arrangements are being made to demonstrate them to cultivators.

With a view to ascertain how far the nature of the fibre of the jute plant is affected by details of cultivation, such as the amount of thinning which the crop undergoes, and what the effects of environment are on the quality, of jute fibre, arrangements have been made to carry out important series of experiments at the *mufassal* agencies of certain jute firms. The experiments, if successful, will be of great value both to the agricultural department and to the jute trade in general, as they will answer the question why the different tracts are recognized by the trade as producing characteristic fibre.

In Assam, Kakya Bombai was again tested at the Karimgunj farm against one of the heaviest cropping local varieties and it continued to show its superiority. There is now a growing demand for

this improved variety in both valleys and arrangements have been made to provide a large supply of seed for next year. A manurial test with bone-meal, ground lime stone, hoacinth ash and cattle manure, applied singly and in combination, showed in each case a profitable increase in outturn of fibre.

In Bihar, jute was grown mainly for the supply of seed to Bengal.

Trials with jute were continued at several farms and other places, including jail gardens, in Lower Burma. In Upper Burma, it was grown at Hopin and Nagu with success. On the high garden land of Yedashe farm a yield of as much as 1,100 lb. of clean fibre was obtained, but yield at other places and in jail gardens were not so encouraging. Further trials are being made in the Irewaddy delta, but the growing of jute in this province appears to be a doubtful business proposition on account of the small advantage of profit in its cultivation over that of paddy and the difficulties and expensiveness of labour in Burma.

SANN-HEMP.

The provinces producing sann-hemp on a large scale are Bengal, Bihar, the United Provinces, the Punjab and the Central Provinces, but the crop is grown all over India, either for fibre or as a fodder plant. The fibre from Bengal and the platean districts of the Central Provinces has the best reputation in the market. Some of the provinces, however, for instance, the Central Provinces, the United Provinces and the Punjab, experience difficulty in the matter of retting water. An artificial process of extraction would not only largely obviate this difficulty but would effect an undoubted gain in nitrogen to the soil; for the amount of nitrogen recovered through avoiding the present wasteful retting process might be as much as 40 lb. per acre, and would open the possibility of green-manuring without loss of a revenue crop. With the aid of a special grant, Mr. Finlow is working in the direction of improving the Method of extraction of sann-hemp and much will depend on his success in solving the problem. Meanwhile, it is gratifying to note that he has succeeded in elaborating a softening process which promises to render sann-hemp fibre fit for use in the textile industries, *e.g.*, for the manufacture of canvas.

Sida.

Experiments with *sida* have been carried on for some years, and a straight-growing plant has now been obtainad by Mr. Finlow. The cultivation of *sida* and the extraction of its fibre are similar in all respects to that of jute, the chief difference being that *sida* can be sown later than either jute or *Hibiscus cannabinus*. Its great advantage over jute, for tracts in which the climatic conditions of Bengal do not obtain, is that, when sown on high land at the beginning of the monsoon it yields a good crop of about 15 maunds per acre of excellent fibre which fetches 20 per cent more than the market rate for first class jute. Triais with *sida* as field crop at Dacca have again given excellent results.

HIBISCUS CANNABINUS.

The improved type known as Pusa 3 is doing well in some foreign countries as well as in India. The preliminary trials given to it by the Agricultural Department of the Union of South Africa proved satisfactory and that department asked for a large quantity of its seed. At Pagu in Burmà it gave an yield of 700 lb. per acre.

SISAL HEMP.

Sisal hemp is now produced only in small quantities grown on an experimental scale. At Mandalay, from a plot planted out in 1911, it gave a yield of dry fibre of 840 lb. per acre. An enterprising cultivator is laying out a small plantation under the advice of the Agricultural Department, near Sedaw.

MADRAS COTTON CROP.

Mr. H. C. Sampson, Deputy Director of Agriculture, was good enough to interview the members of the Madras Publicity Board and to read the following interesting paper on the Madras Cotton Crop,' which he afterwards discussed with the members of the Board and the visitors who were present :—

MADRAS COTTON CROP.

The cotton crop in Madras has passed through various phases since war was declared in 1914. The first result of the declaration of war was a sudden fall in the price of cotton which fell to such a low figure as hardly to pay the cost of cultivation. The immediate result was a considerable drop in the area grown. The price, however, gradually recovered as the demand for cotton increased. This not only had to meet the ordinary demand for cotton, but also had to meet the demand for munition purposes. In 1917, the price was well above the average pre-war price. As the price rose, the area grown under cotton expanded till in 1918 not only was the area grown in Madras greater than ever before known, but the price also had risen above anything imagined. In the cotton season of 1918 the price of cotton was over a rupee a lb. against a pre-war price of about 6 annas.

Now the normal area of cotton in Madras cannot increase indefinitely. Of country cotton, the possible area is limited by the extent of black-cotton soil. If the whole of this area were sown with cotton, it would mean that this crop was grown at the entire expense of food and fodder crops and without regard to rotations. There is no doubt that the high prices did tempt the farmer to grow a larger area than was safe and in consequence he has suffered not only from a shortage of food and fodder, but also from the increased cost of labour following this food shortage. Further by neglecting rotations, he has not only impoverished his land, but has been unable to give this the cultivation necessary to keep weeds in check. For example, in the Tinnevelly tract the cotton crop is sown in September-October, and remains on the ground till the beginning of August, when the plants are pulled out. August is usually a rainless month and it is not possible to cultivate the land then, and the result has been that where cotton has followed cotton, the only cultivation between two crops has been the ploughing given with the first sowing rains, which rather encourage weeds to grow than check them.

If then Madras has been dependent on Indian cottons alone, the extension of cultivation would have been very definitely fixed, and for the reasons given above any extension in area under this crop would be largely counterbalanced by a decrease in acre yield. Madras, however, had another string to her bow in the shape of Cambodia cotton. This is a species of cotton which was introduced some 15 years ago from Cambodia. The history of this cotton and its vicissitudes are interesting, and have a very important bearing on the future of the whole cotton in Madras.

When seed of this was first obtained by the Agricultural Department, it was grown for trial on black-cotton soil. Very little work up to that time had been done on the cotton crop and it was not then realized that this cotton was entirely different to the country cotton both in habit and in its requirements in the way of soil, rainfall, and soil fertilities, etc. Early trials therefore were not particularly successful, and it was only when this was grown under irrigation from wells that its possibilities were recognized. The fame of this cotton and tales of the enormous acre yields obtained spread rapidly, and soon seed was available in all the Southern districts. Its fame, however, spread much more rapidly than did the knowledge of the requirements of this crop and the result was that there was at first a very large extension of the area under Cambodia cotton which again dwindled down as rapidly as it rose. The first zenith of his crop was about 1911 to 1912 and at this time it was grown on all descriptions of soils, on garden lands under wells, on wet lands, on black cotton soils and on red soils. Its cultivation on garden lands was soon given up except in the Coimbatore district. Farmers had made much money out of this crop, but at the expense of their soil fertility and of their grain and fodder crops. This money was very largely sunk in making new wells and in deepening existing wells. It was only in Coimbatore that the garden land farmer realized the possibilities of this crop and worked it into his rotation. Here however the standard of farming is very high and much greater attention is paid to maintaining the fertility of the land.

In wet lands irrigated from tanks, this crop, though at first it replaced paddy, was subsequently only grown when the water-supply was insufficient for a paddy crop. The crop however persisted as a rainfed crop in the red soil areas especially in the deep red soils near the foot of the hills and also on precarious soils in other places, *i.e.*, on such soils where the return from the land was in any case bound to be small. The reason for this is to be found in the habit of the plant. The Cambodia cotton is an entirely different species to the Indian cottons. The latter are essentially deep rooted crops and the tap root penetrates deeply into the soil. The Cambodia cotton on the other hand is shallow rooted crop and is largely a surface feeder. Hence it soon exhausts the surface soil fertility and is much more dependent on a well distributed rainfall than country cotton. A fall of rain which penetrates, say 6 inches into the ground, will immediately cause the Cambodia plant to put on vigorous fresh growth while such a rain has very little effect on a black-cotton soil cotton except to cause the bolls to shed owing to the moisture at the surface causing the cracks in the soil to fill up and thus check soil aeration. In can readily be understood that unless subsequent showers are received, the Cambodia plant soon begins to flag and cannot maintain the rate of growth which it made when rain was received. A subsequent rain may or may not come. If it does it may enable the plant to yield its cotton. If not, the plant will merely keep alive till it rains again. It is this power of being able to temporarily recover after a shower of rain which makes this cotton such a dangerous element in the improvement of Madras cotton, when this crop is grown without the aid of irrigation.

All cottons are naturally perennial plants but all black-cotton soil varieties are invariably treated as annuals. The Cambodia however by holding out hopes of a crop—like dangling a carrot in front of a donkey's nose—has induced people to keep this on as a perennial and it is no uncommon thing to find

Cambodia crops which are two, three and even four years old. This has just suited the inclinations of many farmers. Here is a crop which once sown, will last for three-four years, it requires no labonr except to pick the cotton and with a lucky season and high prices, may bring in a very profitable return. This explains why there are such large areas of these old cotton crops. In the deep red soils near the foot of the hills, which are highly malarious and where labour is usually scarce, large areas of such old crops are to be seen. In the Kallar country of Madura again there are large areas grown because the people are not farmers but have the land and have found a means of obtaining an income from it with the minimum expenditure of labour. In the shallow dry soils of South Coimbatore very extensive areas of such cotton were to be seen and those were grown and left because the seasons in this tract are precarious and such crops are likely to pay as well as any other. This then was the state of Cambodia cotton from 1912—13 to 1916—17. With the gradual rise in price which was taking place at that time the farmer naturally wished to benefit by this and used every means in his power to increase his area under cotton. Once again the Cambodia cotton became a common crop on garden, dry and wet lands throughout the Southern districts and with the continual rise in prices, which, in 1918, touched over a rupee a lb., it was natural that the farmer should strive to win every ounce of cotton which he could and even on good garden lands, crops were retained throughout the year until the season was passed for sowing anything else. Thus, even on the richest garden lands there were large areas of 2 year old cotton standing. 1918-19 stands out as the largest area under Cambodia cotton yet grown in the Presidency and it was estimated that some 3½ per cent of the total yield of cotton in the Presidency, was represented by Cambodia. This estimate, however, has not been fulfilled and the reason is not far to seek.

Now these methods of cultivation, though they may be reprehended as not utilizing the land to its full capacity, may have been justifiable in the eyes of the farmer who naturally had his own pocket to consider. He saw an opportunity of making great profit from this cotton and naturally was not slow in doing what he could to reap the full benefit of these high prices. This outrage against all the recognized principles of agriculture, this neglect of cultivation, of rotations, of weeding and of plant sanitation has brought about results which might have been expected. Such crops alternately flushing with a shower of rain and flagging for want of rain offer conditions most favourable to the attack of insect pests and disease. The plant is there all the time and insects which feed on the crop, have every opportunity to breed and multiply and the same applies to fungus disease. The damage does not end here, however, such diseases do not remain on these old crops alone; but also spread to newly planted crops both of Cambodia cotton and of country cotton. It is very difficult to estimate the extent of damage done by such diseases. These not only weaken the plant but at times kill it out-right. Such loss is very considerahle but is very difficult to estimate. Such diseases as bowever attack the boll can, to a certain extent, be estimated by the damage done to the cotton which is picked and sold. This can be reckoned by the decreased sale price of such cotton. In the Tinnevelly tract one of the buying firms has estimated this loss at atleast Rs. 25 a bale. Forty thousand bales at Rs. 25 means a crore of rupees and this, I consider, a very conservative estimate. This however is only a fraction of the loss caused, because, if the insect or fungus attacks a vital part of the green boll, this will either wither on the plant or will drop to the ground before it has fully developed. Some idea of this damage can be gained by the Director of Agriculture's forecast for the 1918-19 crop. This was estimated, in the case of Cambodia, at 242,600 bales, and deliveries at presses and mills up to date, *i.e.*, from 1st February to date, amount only to 146,970. It is true that more is yet to be delivered as many ryots who reaped the advantages of high prices in 1918, can afford to hold up this crop and have done so in the expectation of the price again reaching the high figures of 1918, but nothing like 40 per cent (valued at about 26 crores) of the total crop. I may here mention that these outturn reports are based on all available information and until this year have furnished a very dependable forecast.

That such diseases were causing a serious loss to the grower first forcibly came to prominence in the summer of 1918 when the second pickings were found to be seriously damaged chiefly by insect attack, but the real seriousness of the situation was only realized when the 1919 crop commenced to come in. The early deliveries of cotton at the Tiruppur market which were the pickings from two to four year old crops showed an appalling state of affairs. The cotton was of a a dull grey colour and was badly stained either dark red or bright yellow. A large proportion of the fibre was 'dead', *i.e.*, it had been killed in the green boll before it was fully developed. It was impossible to gin such kappas properly as it contained so much worm eaten, and unfilled seed, that this was dragged between the roller and the knife and passed through with the lint.

The bulk of this damage was primarily due to the grub of a small moth known as the *pink boll worm*

and it was at once evident to those who know the life history of this insect that the position of Cambodia cotton as a staple cotton was bad and likely to get very much worse before the season was over. This damage was not confined to Tiruppur, but was to be seen in all the cotton markets of the south, and what is a still more serious point is that the attack was not confined to Cambodia cotton only, but had spread to the local Indian cottons.

The life cycle of this insect during the growing season is completed within about fourteen days, The female moth lays some five hundred eggs; these are laid singly either on the young boll or in the cotton flower and hatch out almost at once. As soon as they hatch, they bore into the ovary (*i.e.*, the undeveloped boll) and here they commence to feed on the tender seed. Within a few days they are full grown and bore their way out through the side of the boll and usually pupate or form a chrysalis under the protecting leaves which cover the base of the boll. From this the moth emerges and immediately commences to repeat the life cycle. Thus, not allowing for casualties, one female moth within fourteen days produces some 250 female moths, and each of these within fourteen days produces 250 female moths. It does not need any great power of arithmetic to reckon how rapidly such an insect can multiply during a period of five months when the cotton plant is in boll. In fact it is a matter of surprise that any bolls escape. Careful examination in the field at different times during the bolling season was made last year by the Government Entomologist and from 60--80 per cent of the bolls were damaged. Many of them contained several boll worms.

The damage done by this insect has thus last year run into crores of rupees and may be summarised as follows :—

(1) Large numbers of young bolls drop to the ground because the grub has damaged some vital part of the boll.

(2) Attacked bolls usually open prematurely and any undamaged fibre is very weak as it is not fully mature.

(3) The excreta of the grub dirties the cotton.

(4) The cotton fibre is stained a dark red.

(5) The holes made in the green boll when the insect emerges lets in moulds which feed on the cotton fibre thereby weakening it and at the same time covering the fibre with black spores which give the ginned cotton a dull grey colour.

(6) The seed in prematurely opened bolls is soft and full of moisture, and when such kappas is stored, it heats and deteriorates greatly both in colour and in strength.

One of the worst features of this attack is the unfair distribution of the damage done. The disease was fostered by the thousands of acres of 2—4 year old crops, *i.e.*, by careless, lazy and bad farming practice. Those farmers who really farmed their lands well and who had invested a considerable out-lay of time, money and labour in growing this crop systematically and carefully, were the greatest sufferes as the insect did not confine its attacks to 2—4 year old crops, but migrated to the crops sown that year as soon as they came to flower and young boll. The 60—80 per cent of damaged bolls referred to above referred to well grown crops of that season's sowing

In 1918 when the damages caused by this pest first began to show how serious the damage was, officers of the Agricultural Department consulted many ryots of the Coimbatore District. It was generally admitted that these 2—4 year old crops were the cause of the spread of the pest and that they were a serious menace to the future of Cambodia cotton. Many such farmers whose belief in the powers of the district administration still savours of a period of half a century ago, expressed the opinion that the Collector should issue orders that the old crop should be pulled out, and they were unable to realize that the Collector had not power to do so. This opinion is sound. It means that it the crop is pulled out by a certain time the moth of the boll worm has nowhere to lay its eggs and the pest, to a great extent, dies out. Further, this method has been tested in other countries more especially in Egypt and has been attended with very considerable success.

Since that time however the Pest Act has become law and the Agricultural Department recommended to Government that it should be enforced in the Coimbatore district for the eradication of all old crops of Cambodia. Cambodia cotton alone was specified because Indian cottons grown on black-cotton soil are always pulled out at about this season. The time fixed for the eradication was the 1st August, by which time the second or summer picking was practically completed. Its scope was limited to the Coimbatore district, excluding the upland plateau of Kollegal, as it was considered that experience should be gained in working the Ac- thoroughly in a limited area rather than covering the whole Cambodia tract of the south where control of the work could not be efficiently supervised. The work was carried out by the revenue and village officers and with the assistance of officers of the Agricultural Department. The work of the latter was

largely educative. Tahsildars, who were appointed appellate officers under the Act, and revenue inspectors and village officers, who were appointed inspecting officers, had all to be taught something of entomology and the life history of this particular pest. The damage done to the crop had to be shown to them as well as the living specimens of this grub. Farmers in the villages had to be met and the reasons why the crop had to be pulled up, explained to them. Very few of them realized why Government had enforced the Act. Some thought that Government did not want them to grow cotton. Others again thought it was merely a means to increase the area under food-grains. In one village the people thought that it was done as a prophylactic against influenza. Very few of them realized also what damage was being done to their crops. None had ever thought of opening the green bolls on the plants and were dismayed when they discovered that nearly every boll was riddled by this grub. When once the farmer realized the extent of the damage done, there was no difficulty in getting the crops pulled out. In fact very many of them appreciated the measures taken and realized that the eradication was done solely in their future interests. This was specially the case in the well farmed garden lands of the district. Where the standard of agriculture was highest the necessity for the measures taken were most appreciated and vice versa.

Certainly many farmers incurred a temporary loss, but this was not so great as was imagined. As already explained the better quality of cotton and the highest acre yields are obtained by sowing annually. The seed is sown in September-October and picking commences in April. The main season picking is completed in May. After a short rest the plant sends out secondary shoots which give a second or summer picking in June-July after which the plants are pulled out to make room for other crops, usually either ragi or cholam. Where agricultural practice is backward and the Cambodia crop is treated as a perennial, a two or three year old crop will give a picking in January-February. If rains are favourable, it may give another picking in May, and again another picking in August-September, but as practically every boll on such crops was damaged by the boll worm, the yields are only small and the quality is so bad that it is difficult to dispose of the crop. The experience gained in working the Act during this past season will allow of considerable expansion of the work in the future and it will, this next season, be possible to extend the area to the adjoining districts, and within two years, it is hoped, that it will be possible to deal with the whole Cambodia area of the southern districts. Since the work last season was confined only to the Coimbatore district, the full effects of the measures taken this year may not be apparent as there is nothing to prevent this pest from coming in from Salem, Trichinopoly and Madura districts, where there are still large areas of old crop still standing.

There is no doubt whatever that the cultivation of Cambodia cotton on the lines on which it has been allowed to develop was deading to a time at no very distant date when the crop would have become extinct and since the damage was extending also to the local cottons there is no doubt that these would also suffer, not to the same extent perhaps, but sufficient to reduce very considerably not only the acre yield but the price.

In no other country in the world is cotton of the same species as Cambodia, treated other than as an annual crop, and its future in Madras depends on its being treated from now onwards as such. When it is treated as such there is an immense future before it. On garden lands a good crop will yield more than a bale per acre of cotton, and it requires less irrigation than any other garden crop. It not only means that it will be a source of much profit to the farmer, but it also means, if this cotton is produced in sufficient quantity and can maintain its quality, that India will become much less dependent on foreign countries for the supply of better qualities of yarn and cloth.

THE PAPER INDUSTRY IN JAPAN.

The *Journal of the Royal Society of Arts* says:—

The manufacture of paper has been carried on in Japan for many centuries. The product now generally known as Japanese paper was described by the early Dutch traders nearly 250 years ago. This product has served all the uses to which we put paper—book printing, covering for doors and partitions, writing and wrapping—and, in addition, has been utilised by the Japanese as a substitute for string, cloth, oilcloth, leather, and even wood, iron and glass. Its excellent lasting qualities and its superiority over machine-made papers have led to its utilization for a number of purposes for which foreign paper would be unsuitable. These advantages are due to the fact that in making this paper the Japanese use the tough and pliant inner bark from three or four species of deciduous trees, possessing long, tough, fibre cells, and this bark is not cut or hacked in transforming it into pulp, but is separated by pounding and beating, so that the long cells remain unbroken.

In the manufacture of this paper the form is held so that the parallel splinters or threads run from left to right. The form is then lifted and lowered at right angles to this direction, causing the fibres of the material to lie in one direction. Japanese paper is consequently torn easily one way, but with difficulty the other. There is no special sizing or glazing, but each sheet has a rough and smooth side, resulting from the process of drying. The shaped sheets are pasted with a large brush on a smooth planed board to dry, and the side against the board remains much smoother than the outside surface. The smooth side is used for book printing and the two rough sides are folded against each other in binding the book, so that Japanese books consist of double sheets of thin paper.

From an interesting monograph on the paper industry in Japan, prepared by the Far Eastern Division of the U.S. Bureau of Foreign and Domestic Commerce, and from which the foregoing particulars have been taken, it would appear that all Japanese paper is very porous, and consequently cannot be written on with pen and ink, although it is well adapted to the Japanese mode of writing with brush and India ink. Smooth, firm, machine-made paper would not absorb this ink so well, and is therefore not in demand. There is no bleaching, and all Japanese paper is of a yellow tint, although sometimes whitened by the ingredients used to soften it in manufacture.

Paper produced in Japan may be divided into two general kinds—Japanese paper as described above, and foreign or machine-made paper. Aside from the nature of the product, the two industries are further distinguished by the fact that the farmer is largely a household industry, and the latter a factory industry. The production of the Japanese paper in 1916 is officially valued at over £2,500,000; no figures as to quantity are available.

The principal raw materials entering into the manufacture of Japanese paper are the inner barks of the paper mulberry trees (*Broussonetia papyrifera, Edgeworthia papyrifera, Wickstroemia canesens*—a small bush related to the spurge laurel, *Morus alba*—white mulberry tree) and the *Aphananthe aspera*. The classes of paper produced from these materials are broussonetia papers, made from kodzu fibre; edgeworthia papers, made from mitsu-mata and from a mixture of mitsu-mata and kodzu; wickstroemia papers, made from the best of morus alba; and suki-gaeshi papers, made from old or used papers.

The names of the various kinds of paper of each class, the province where made, the size of the sheets, and the number of sheets and the weight per quire, are given on p. 227.

Japanese papers derive their names almost exclusively from the towns or districts where they were originally made, and this geographical distinction perhaps accounts to some extent for the difference in grades. A short description of each of those figuring in the export trade is given below:—

Yoshino, manufactured in the town of Yoshino, in Yamato Prefecture, is a fine paper, used extensively in the lacquer industry. The mould is a net made of finely wrought bamboo sticks bound together with silk thread, and the texture of the product is indicated by the figures in the following table, one quire (50 sheets), or about 6·12 square metres, weighing only 35 grammes. The paper is so firm, however, that two or three layers used to filter thick lacquer are not only uninjured by the wringing and pressing through of the lacquer, but are afterwards smoothed out, dried, and used several times over for the same purpose.

Tengujo, literally "prize-crowned-labour," excels in fineness and pliancy the thinnest silk papers, and is also much stronger. It is manufactured in Mino Province, and is extremely well adapted for pasting on common window panes to make them opaque.

Mino is pure broussonetia paper made in the Province of Mino, and is noted for its firmness. It is used for covering woodenwares in the process of lacquering, for cord, and as a covering for the lattice of sliding doors, as it is very transparent. The 1916 production was 275,293 reams.

Hanshi, literally "half-paper," is so-called because of its common use in book manufacture, where only half the sheet is used, the rough surface being turned in. Its widest uses are for writing printing, and paper handkerchiefs. Production in 1916 amounted to 32,66,195 reams of 100 quires (6·12 square metres) each.

Usuyo, or gampi, is at present used largely abroad as a copying paper in business houses, although its pliancy, smoothness, strength, and lightness will probably find other uses for it, as it becomes better known.

Torinoko is a semi-foreign paper which resembles parchment; and has enjoyed an increased sale abroad, especially in China, as a substitute for foreign parchments.

Renshi, literally "ream paper," is an imitation of the Chinese-sized papers put up in the same quantity, and is sold almost entirely in China.

Toyoshi, "Far East paper," is also sold almost exclusively to China, where it is used for a variety of local purposes.

Other varieties of Japanese paper, which do not figure in the export trade, but which are used largely in Japan, include the following:—Hankiri, resembling hanshi, used for account keeping and letter

writing; nishi-no-uchi and shi-fu-gami, made from broussonetia bark in very large sheets, are exceedingly strong, and are used as a fabric; atsu-gami and senka are very thick strong papers used in making imitation leather and oil papers; another heavy, starched paper, ko-sugi, is cheaper, and is used for cleansing purposes; iyo-masa is a soft paper, and is well adapted for wrapping dried plants; hosho, one of the most valuable and expensive Japanese papers, is thick, very strong, of even texture and gloss, rich in starch, and often contains alum. It is used as the Government paper for all important legal acts, as a wrapping paper for expensive presents, and was formerly used for making paper-money. It is made in the celebrated five villages of Hoshi district in Echizen Prefecture.

Ju-mon-ji and jidzuki, otaki,-gami, are large sheets of very thick, stout paper, used principally in the preparation of leather paper.

Suruga-ban-shi is a thin writing paper, and is also used for cleansing purposes and printing.

Shoji-gami contains about 20 per cent of Edgeworthia pulp, and serves principally as the covering for lattices or shoji (sliding doors) and as a substitute for window-panes.

Ita-me-gami, or board paper, is made by fastening together, with wheat-starch paste, a number of sheets of common paper. This pasteboard is frequently made from waste paper, old business documents, and other used paper, covered with a coating of fresh paper of good grade.

Papier-Mache.—Hari-nuki, or Japanese papier-mache, is also prepared from waste paper, but the process differs in that the hari-nuki is not prepared from paper reduced to pulp after being soaked in water, as is papier-mache, but is made like pasteboard, the couching being done on wooden forms.

Name of Paper	Province where made	Size of Sheets	Sheets per quire	Weight per quire
		Centimetres.	Number.	Grammes.
Broussonetia Papers:—				
Yoshino-gami	Yamato ...	48×25·5	50	35
Mogami-gami	Uzen	31×27·5	50	25
Tengu-jo { Pure	Mino	39×27	48	56
Tengu-jo { Figured	Do.	39×27	48	...
Mino-gami	Do.	40×28	50	137
Mon-shi	Do.	40·5×28	50	125
Han-shi	Tosa	32×24·5	40	67
Ko-ban-shi	Musaski ...	26×20	50	87
Hankire	Koshiu ...	52×39	50	200
Nisho-no-uchi	Do.	47·5×35·5	50	254
Shi-fu-gami	Iwaki	53·5×41	50	256
Atsu-gami, okiban	Koshiu ...	44×33·5	20	240
Atsu-gami, koban	do.	42×29·5	20	200
Senka	Echigo ...	56×39	20	250
Do.	Iyo	44×32	20	220
Ko-sugi	Tosa	25×19·4	48	72
Iyo-masa	Iyo	52×39	48	372
... ...	Echizen ...	57×44	48	852

Names of Paper	Prouince where made	Size of Sheets	Sheets per quite	Weight per quire
Jidzuki-Otaka-gami	Musashi ...	60×42	20	600
Otaka-gami or Jumon-ji	Iwaki ...	66×46	20	800
Edgeworthia Papers :				
From Mitsu-mata only—				
Suruga-banshi	Suruga ...	62×48	50	250
Hankire	Koshiu ...	55×16	50	84
Nori-ire...	do.	43·5×32	50	237·5
Mixture of Kodzu and Mitsu-mata bast pulp—				
Haushi	do.	34×24	50	75
Shoji-gami	do.	40·5×27·7	50	135
Take-naga-gami	do.	67×26	50	325
Hosho	do.	47×34·5	50	375
Wickstroemia Papers :				
Gampi-shi, first quality	Mino	38×28	48	52
Usego, uncut gampi	do.	50×36	48	96
Kuva-kami Paper :				
First quality	Koshiu ...	48×34·5	20	135
Second quality	*do*	41×27·5	50	164
Suki-gae-shi Papers :				
Chiri-gami, grey	Musashi ...	40×26·5	50	150
Suka-gae-shi, best quality, grey-white ...	do	31·5×26·5	50	75

Sheet after sheet of light waste paper is stuck with wheat-starch paste, and spread out over the form until the required thickness is obtained. The board is then cut, dried, and lacquered, and many small durable articles are made from it, such as dolls' heads, plates, saucers, tea caddies, and pipe-cases. These articles closely resemble lacquered wood and far excel papier mache in firmness and elegance. They are strong, durable, and surprisingly light and cheap. Kara-kami, or paper for hanging, is made in sheet size in a very small quantity, owing to the light demand.

Crepe Paper.—By means of two very simple wooden tools—a lever press and mould—the smooth surface of several bark papers is twilled, and stiff cardboard is made soft and pliant, and given a surprising elasticity. The lever press is made either of evergreen oak or some other hardwood, and stands, on a foundation consisting of a large, heavy board, through which two perforated posts are fastened as tenon bearers, and between which lies the fulcrum of the lever. The moulds are large sheets of thick brown paper, which are grooved in parallel furrows in several directions, and show considerable elasticity when moistened. The paper to be twilled is wrapped around a wooden cylinder, varying in diameter from 2 to 3 inches, and in length according to the size of the paper, which also determines the height to which the tenon for the fulcrum of the lever is raised.

The sheets are moistened by sprinkling, and subjected for an hour to a mild-pressure between alternate layers of wet paste-boards. The moistened sheets are then placed on top. In this arrangement of layers the single sheets must lie even with the separating sheets, and have their edges parallel to-

those of the moulds. These layers are wrapped tightly around the cylinder, making it about 6 or 8 inches in diameter. The cylinder is then diagonally wound round with a strip of hemp canvas and placed in the press, where pressure is applied by six or eight jerks on the roll, which is compressed in the direction of its axis. It is then taken out, and the thin sheets removed and placed on the forms or moulds in another position. After this process has been repeated eight or ten times in different positions, the paper is considerably smaller in length and width, but is stretched somewhat before being used. With each new operation the markings from the moulds become constantly finer and more regular, and shrinkage of the sheets and increasing softness and pliancy accompany this transformation.

Leather Paper.—Japanese leather paper is very soft, has great elasticity, and resembles calf leather. It is used in the manufacture of leather portfolios, tobacco bags, pipe cases, boxes, small chests, and other articles, and also as a floor covering, and as a protection from rain over wooden shoes. The paper is admirably adapted for hanging in salons. The process of manufacture is briefly as follows :—

1. The paper to be treated is spread out on a board, the smooth side up, coated with thin rice paste, to which lamp-black has been added, and then hung on horizontal poles to dry for several days.

2. The twilling is done by the same process employed in making crepe paper.

3. A coating of perilla-seed oil is applied, and it is allowed to dry in the sun from five to twenty days, according to the time of the year.

4. A coating of paste solution mixed with the dye to be used, generally red oxide of iron, orpiment, indigo, india ink or other dyes, is put on.

5. When dried the paper is impregnated with lacquer by two workmen sitting opposite each other, who smear their hands with lacquer and beat them quickly on the sheet, after which it is dried on a frame.

6. If the leather paper is to be figured, carved wooden moulds are pressed in at the close of the crepe process, and the colours applied by paper stencil plates. A metallic reflecting surface is obtained after the figures are made by fixing bronze powder with lacquer, and polishing when dry. Some papers are dried in the smoke of rice straw and then rubbed.

Paper Fabric—The warp of Japanese paper fabric consists of silk threads and the woof of paper threads, made of broussonetia fibre. To make these threads, the paper is laid lengthwise over the narrow side of a thick board, provided with feet to lend it stability, and fastened at both ends with iron clamps. It is then cut into strips, long ribbons being produced by cutting the paper not quite to the end. These are rolled into thread on a stone slab by hand. The connecting edges are cut on both sides so far through that the single threads hang together by a width of only ¼ inch, and these connecting places are twisted to form a continuous thread.

In making paper fabric for clothing, the threads are twisted from right to left, like those of the silk woof for crepe silk, and run in the fabric alternately, two right-twisted woof threads following two left-twisted ones. When finished the fabric is washed in boiling straw-ash lye, dried, and stretched. It acquires in this process an appearance of being twilled and is shrunk considerably. It is then dyed in various patterns. 150 years ago this fabric was very popular in Japan for women's summer clothing, but the more durable cotton fabrics have supplanted it at a much lower price, and now only a few small factories engage in the industry.

Oil Paper and Waterproof Paper.—Oiled papers are made for two purposes in Japan, one for use as transparent paper in lanterns, etc., and another for protection against water, as for umbrellas, and regular oil and leather paper. For this product perilla-seed oil is invariably used, and broussonetia paper of a stout grade is generally employed. The paper is made pliant, either by a kneading, or by the crepe process already described, and is pasted in the thickness desired with glue or paste made from the flour of the common brake. The sheets are then treated with a mixture of lamp-black (for black waterproof cloaks) and the juice of unripe persimmons, and dried in the sun for five days. Two coats of perilla-seed oil boiled with persimmon juice are then applied, drying taking place between the applications. The entire process requires about 15 days in good weather. Though far inferior in appearance and durability to oilcloth and western waterproof cloth, oil paper has served its purpose in Japan for several hundred years.

Since the oiled Japanese paper umbrella could not be used as a sunshade, nor the unoiled variety as a protection from the rain, the adoption of the silk umbrella, suitable for all weathers, has been rapid, and the Japanese manufactured silk umbrella is one of the few foreign articles used generally throughout the interior as well as in the large cities.

Foreign and Machine-made Paper.—The total production of European, foreign or machine-made paper in Japan in 1916 amounted to 558,588,246 lb., as compared with 197,506,826 lb. in 1907. The paper produced in 1916 was made in 51 modern

mills, representing a total capital of more than £3,000,000. There has been a steady increase in production in recent years, as a result of which the imports of every variety of paper have decreased considerably, and there is reason to believe that the industry is firmly enough established in Japan to withstand any foreign competition. This is especially true of those kinds of paper, the output of which is on a large scale, and in the manufacture of which the Japanese are organizing for scale production by concentrating the industry on modern lines in the hands of one or two large companies.

NEW SOURCE OF TURPENTINE AND ROSIN IN INDIA.

The following article appears in the current number of the *Bulletin of the Imperial Institute* (London):—

In a previous number of the *Bulletin* (1915, 13, 351) an account was given of the results of investigation at the Imperial Institute of the turpentine oil and rosin obtained by the distillation of the gum-oleo-resin of *Boswellia serrata*. Since then further samples of these products, as well as samples of gum derived from the same source, have been examined, and their commercial value and uses investigated. An enquiry has also been carried out in India at the Forest Research Institute, Dehra Dun, and a report on the methods of tapping the trees, the preparation of the products, their chemistry, commercial value and industrial uses, is incorporated in a paper entitled "Note on the preparation of Turpentine, Rosin and Gum from *Boswellia serrata* (Roxb.) gum-oleo-resin," by R. S. Pearson, F.L.S., I.F.S., and Puran Singh, F.C.S., published in *Indian Forest Records* (1918, 6,303). A summary of the information given in this paper, and the results of examination of the products at the Imperial Institute are given in the present article.

DESCRIPTION AND DISTRIBUTION OF TREE.

Boswellia serrata, Roxb., is a moderate-sized tree, belonging to the natural order Burseraceæ. A number of important resins are obtained from plants in this order, including African olibanum or frankincense, derived from *Boswellia carteri*, Birdw., and *B. Frereana*, Birdw., myrrh from *Balsamodendron* spp., bdelliums from *Commiphora* spp., manila elemi from *Canarium* spp., west Indian elemi from *Dacroydes hexandra*, Crieseb., and American elemi from *Bursera gummifera* Linn.

According to some authors there are two forms of the tree, *B. serrata* proper, which occurs in the intermediate northern and southern dry zones, and *B. serrata* var. *glabra*, Hook f., a native of North-West India, which Roxburgh regards as a distinct species, under the name *B. glaber*.

Pearson and Puran Singh state that *B. serrata* is found from the Sutlej extending eastwards to Nepal on the outer slopes of the Umballa and Saharanpur Siwaliks. It is common throughout Rajputana, Bihar and Orissa, in the Circars, the Central Provinces, Khandesh, especially on the slopes of the Satpuras, in the Deccan and Carnatic, but it is not found in Assam. It is rare in Burma, but according to *Agricultural Ledger* (1900, No. 10, p. 101) it is said to attain a height of 100 to120 ft. with a girth up to 10 ft. and over in the Pegu Forest Circle. Elsewhere in India it only attains a height of about 40 to 60 ft. with a girth of 3 to 5 ft. The tree is often the dominant plant on hot rocky hillsides, and is frequently the forerunner of better forests as soon as protection from fire and grazing is introduced.

Information has been collected from certain localities as to the number of trees available for tapping. From the figures given the tree appears to be most abundant in parts of the Central Provinces; in the Nagpur-Wardha Division there are approximately 9,000,000 available in the east Pench Range and 2,500,000 in the West Pench Range; whilst there are 5,000,000 in the Chandi Range, 3,500,000 in the Burhanpur Range and 1,250,000 in the Khandwa Range of the Nimar Division. The Conservator of Forests, Berar Circle, however, expresses the opinion that the last three estimates are high and should be treated with caution. In the North, East and West Khandesh Divisions of the Bombay Presidency also there are large numbers of the tree. The total number available for tapping in selected areas of these three divisions amounts to nearly 12,000,000, of which more than half occur in the Shirpur Range of North Khandesh.

METHODS OF TAPPING.

Difficulty having been experienced in ascertaining the best method of tapping *B. serrata*, experiments were undertaken in widely separated districts.

In the Nimar Division, Central Provinces, 1,023 trees were tapped from January 21 to February 23, the average yield of gum-resin per tree being as follows:—

Girth of tree.	Average yield oz.
24 to 30 in.	... 0·9
30 to 36 in.	... 1·3
36 in. and over ...	... 1·8

In the areas tapped there were eight trees per acre with a girth of 24 to 30 in., seven trees 30 to 36 in. and eight trees 36 in. and over. For a working season of five months, the yield per acre would be:—

Girth of tree	Yield per acre. lb.
24 to 30 in.	2·27
30 to 36 in.	2·95
36 in. and over	3·58
Total ...	8·80

The trees were tapped by shaving off a girdle of bark one foot broad to a depth of about half the thickness of the bark, and "freshing" at definite intervals. It was found that the gum-resin should be collected and the cuts "freshed" at least every fourth day *to obtain the highest yield of gum-resin*. As a general rule, old trees with black bark, dwarfed and *suppressed trees, and trees with a short boll*, yielded no gum-resin, whilst this was the case also with a large number of healthy trees of small girth, On the other hand all sound and vigorous trees of 30 in. girth and over, all trees attacked by borers or otherwise diseased, and generally all hollow trees, yielded well.

Further experiments conducted during the rainy season in Nimar gave better results as regards yield than those referred to above, which were obtained *during the dry season*. The average *yields of gum* resin per tree in thn later experiments were 5·0 oz. in July and 7·6 oz. from other trees tapped in August. In this case, however, the gum-resin had absorbed water from the rain, which rendered it difficult to deal with subsequently in the solvent stlll, where the gvm is separated from the rosin and turpentine.

Two series of tapping experiments were carried out in the North Khandesh Division of the Bombay Presidency. The method of tapping adopted was to remove a band of bark one foot broad all round the trunk, and nearly as deep as the cambium, at a height of 3 ft. 6 in. from the ground. The gum-resin was collected and the tapping wounds "freshed" every five days.

Ninety trees 24 in. in girth and over produced, as the result of nine collections, a *total average yield* of 1·07 oz. per tree, during the months of June and *July. Another series of experiments with ninety* trees was conducted over a period of seven months (December to June). In this case the "freshing" consisted of removing a thin layer of bark from the upper half of the cut and a further ½ in. or so of bark from above the old wound. In forty-five of the trees the bark was bruished above the "freshed" wounds, but it was found that this reduced the yield enormously. The following yields of gum-resin were obtained trom the unbruised trees:—

Girth	Number of trees	December 1916	January 1917	February 1917	March 1917	April 1917	May 1917	June 1917	Total	Average per tree
		oz.	*oz.*	*oz.*	*oz.*	*oz.*	*oz.*	*oz.*	*oz.*	*oz.*
24 to 30 in.	15	33·6	30·0	50·4	67·6	46·4	41·2	5·6	274·8	18·3
30 to 36 in.	15	38·4	64·0	63·2	57·6	69·6	53·6	15·2	361·6	24·1
Above 36 in.	15	129·6	138·0	171·2	209·6	140·4	169·2	21·6	679·6	65·3
Total ...	...	201·6	232·0	284·8	334·8	256·0	264·4	42·4	1,316.0	35·9

The above results show that the largest trees give the greatest yield of gum-resin and that the flow increases up to a certain point as tapping is continued. The flow reached its maximum at about the twentieth time of "freshing."

The low yields obtained in June in both series of experiments in North Khandesh are attributed to the fact that the rainy season commences in that month. Further drawbacks to the industry being carried on during the rainy season are the difficulty of moving about the forests at that period, and the lack of labour in the forests owing to the high wages paid for agricultural work at that time of year. It was noticed in the North Khandesh experiments that trees with thick bark yield more gum-resin than those with thin bark, whilst large trees yield much more per square inch of wound surface than small trees, and it is doubtful whether it will pay to tap the latter.

Tapping operations have been carried out for generations by the villagers in the Sheopur Range

in the Gwalior State, and the results prove conclusively that the tapping of *B. serrata* can be carried out successfully on a commercial scale. It is estimated that the natives, who work generally in pairs, can collect ten to twelve maunds (823 to 987 lb.) per pair per season. The method of tapping is to make a preliminary blaze about 4 in. wide and about 4 feet from the ground, towards the end of the rainy season. About a month later the wound is "freshed" by cutting off a thin shaving of bark all round the stem, over half the depth of the old blaze, and taking in 2 in. of new bark on the upper edge of the original wound. A similar "freshing," is made at intervals of about a week until the end of March, when collection stops. The yield of gum-resin from the first "freshing," is small, but it increases until the fourth "freshing," after which it is said to remain practically constant. No very definite information was obtained as to the yield per tree by this method of tapping, but twenty average trees which had been once "freshed" gave a total yield of 10 oz., and twenty others which had been twice "freshed" gave 28 oz., whilst two abnormal trees, twice "freshed," yielded 22 oz.

As regards the effect of tapping on the trees it was found that out of the 1,023 trees tapped in the Nimar experiments, 993 had, for all intents and purposes, completely recovered when they were inspected. Three years after tapping had taken place ten trees were badly damaged, and twenty were dead, but all the latter were old, smothered with the parastic Loranthus, and severely attacked by insects. The most definite proof is available from Gwalior that no serious damage is done to the trees by tapping, provided that the operation is confined to a band 8 to 12 in. wide, and subsequently "freshed." In that locality, the trees had been tapped in this way year after year for generations, and not a single tree was found to have been killed.

From the experiments conducted in Nimar and Khandesh, and also from the corroborative evidence obtained from Gwalior, the following conclusions were drawn as to the best methods of tapping *B. serrata* gum-resin :—

(*a*) The method of tapping should consist of shaving off a thin band of bark about 6 inch broad, 2 feet to 2 feet 6 inches from the base of the tree.

(*b*) Tapping should generally be commenced in November, and should stop before the break of the monsoon.

(*c*) "Freshing" should be undertaken every fourth or fifth day, and should consist in removing a thin shaving of ½ inch to 1 inch of new bark from the upper edge of the original belt, and carrying down the "freshing" to within an inch of the lower edge.

(*d*) Tapping of trees below 30 inch in girth is not advocated.

(*e*) Individual trees which yield little gum-resin after the initial tapping, and after the first "freshing," should be, excluded from the operations.

(*f*) The effect of tapping on the trees need cause no serious apprehension.

Taking into consideration estimates given by various forest officers, the cost of collection of the gum-resin is considered to be probably about 5 rupees per maund (=about 9*s*. per cwt.) It is estimated that the total number of trees available for tapping in various localities would produce about 27,000,000 lb. of gum-resin per annum. This figure is based on the average yield per tree obtained in the North Khandesh experiments, and on the assumption that each would be tapped every third year.

COMPOSITION OF BOSWELLIA SERRATA GUM-RESIN.

From the results of analyses of eight samples collected by the Forest Officer at Khandesh during 1917, the average composition of the gum-resin may be taken to be as follows :—

	Per cent.
Moisture	10 to 11
Turpentine oil	8 to 9
Rosin	55 to 57
Gum	20 to 23
Insoluble matter	4 to 5

PREPARATION OF BOSWELLIA SERRATA TURPENTINE OIL, ROSIN AND GUM.

Messrs. Pearson and Puran Singh give a rough design of a plant proposed for the preparation of Boswellia products. The process is based on experiments conducted at the Forest Research Institute, Dehra Dun, but the plant is purely of an experimental nature, as certain factors remain to be determined owing to the tests having been made in an adapted still. The plant consists of a solvent extractor and a steam still, both fitted with condensers; two settling tanks; a solvent storage tank; turpentine, solvent, and resin receivers; and a tank for collecting the sludge.

Two methods of extraction are suggested :—

(1) *Solvent extraction followed by steam distillation*—The solvents recommended are light petroleum (boiling point 80° to 110° C.) or trichlorethylene (boiling point 88° C.). The latter solvent possesses the advantage that it is non-inflammable and also that it is more readily expelled from the gum-resin, but it is not so easily recovered. The

solvent dissolves out all the constituents except the gum and woody impurities. After allowing impurities to settle out, the solvent solution is run into the still, and the solvent gradually distilled off with the help of the steam jacket. Steam is afterwards passed in, and the turpentine oil thus distilled off. The rosin can finally be run off in a molten state into barrels. The residual gum retains about an equal weight of solvent, the recovery of which is effected by treatment with superheated steam. This method possesses the disadvantage that the turpentine oil retains traces of the solvent which alters its constants.

(2) *Steam distillation following by solvent extraction*,—The turpentine oil is first distilled off the crude material by superheated steam at 120° to 130° B. By this method no water condensation takes place in the still, thus obviating the absorption of water by the gum. The residual mixture of gum and rosin is afterwards separated by treatment with the solvent as before. The advantages of this second method are that the turpentine is free from the solvent, and that the gum and rosin being in a dry state after the removal of the turpentine, are readily acted upon by the solvent.

COMMERCIAL VALUE OF SAME.

Two samples of turpentine oil prepared from the gum-resin of *Boswellia serrata* have been examined at the Imperial Institute. A summary of the results of examination of a sample received in 1914, is given below in comparison with those obtained in the case of a sample received in 1917.

The earlier sample consisted of rectified oil with a slight greenish-yellow tinge and a sweet agreeable odour. The second sample was a pale yellow oil, with an agreeable odour very similar to that of the previous one.

The two samples of oil were submitted to chemical examination at the Imperial Institute with the results shewn in the table below. The constants obtained in India in the case of a sample of re-distilled oil, from which the fraction of high boiling residue had been eliminated, prepared by steam distillation on a large scale at the Forest Research Institute, Dehra Dun, and the usual constants of commercial American and French turpentine oils are included for comparison.

......	Results obtained at the Imperial Institute		Results obtained in India	Commercial turpentine oil	
	Sample No. 1.	Sample No, 2.	Re-distilled oil	American	French
Specific gravity at 15-15° C. ...	0·8446	0·8523	0·8371 (at 22° C.)	0·858 to 0.877	0·865 to 0·875
Optical rotation	+31° 24′	+25° 57′	+32° 30′	+9° 30′ to + 14°17′ (rarely slightly lævo-rotatory.)	—29° to —33°
Acid value	...	...	...	...	...
Ester value before acetylation ...	2·6	3·0	...	...	...
Ester value after acetylation ...	36·4	54·3	...	...	...

The results of fractional distillation were as follows :—

Results obtained at the Imperial Institute.

	Sample No. 1 per cent.	Sample No. 2 per cent.
Fraction boiling at—		
153° to 160° C. ...	89	56
160° to 170° C. ...	11 *a*	24
170° to 180° C. and above.		20

a All between 160° and 180° C.

Results obtained in India

	Original oil per cent
Below 160° C.	53·0
160° to 167° C.	17·5
167° to 180° C.	11·0
Above 180° C.	22·5

	Re-distilled oil per cent.
Below 155° C.	87
155° to 160° C.	8
Above 170° C.	5

In the case of sample No. 1 the fraction boiling at 153° to 160° C. was re-distilled and practically the whole passed over at 155° C.

For comparison with the above figures it may be stated that 85 per cent of American turpentine oil usually distills between 155° and 163° C., and 85 to 90 per cent of French oil between 155° and 165° C.

It was found that the Boswellia turpentine oil readily dissolved resins such as colophony, dammar, sandarac and soft copal, but varnishes prepared at the Imperial Institute in this way with both samples of oil were less lustrous and quicker in drying than varnish prepared with ordinary commercial turpentine under the same conditions.

The two samples of oil received at the Imperial Institute were submitted to various firms for technical trials and commercial valuation with the following results:—

Sample No. 1.—Specimens of this oil, which as already mentioned consisted of rectified oil, were submitted to several turpentine oil merchants and distillers, and to varnish manufacturers. The general opinion expressed was (1) that the oil is of very good quality and closely resembles American turpentine oil, except as regards the smell, which is regarded as peculiar though not unpleasant, and (2) that the Boswellia oil could be successfully employed like ordinary turpentine oil in the manufacture of varnishes.

All the firms consulted thought that the Boswellia oil would be readily saleable in the United Kingdom. One firm stated that its commercial value should be approximately equal to that of American turpentine oil though the difference in smell might constitute a slight drawback. Another firm considered that the oil would find a ready market in the United Kingdom "if it could be sold at about 25 per cent under the price of American turpentine oil, and a third valued it at about 30*s*. per cwt., with American turpentine oil at 37*s*. per cwt.

Sample No. 2.—This was submitted to two firms of varnish manufacturers.

The first firm stated that they had prepared for comparison two varnishes, one with genuine American turpentine oil, and the other with the Boswellia turpentine oil, the remaining constituents in each case being the same, and had found that the Boswellia turpentine oil rendered the varnish slightly dull, whereas the varnish made with American turpentine oil remained bright. Equivalent quantities of Boswellia turpentine oil and American turpentine oil gave varnishes of different viscosity, that made with Boswellia turpentine being considerably thinner. The drying and "face" of the finished varnishes were however practically identical.

The firm considered that as a substitute for American turpentine oil the Boswellia oil would probably be placed between French or Spanish and Swedish or Russian turpentine but they were unable to assign a definite commercial value to it under present conditions.

The second firm reported as the result of practical trials that this turpentine oil has a tendency to accelerate the drying of varnishes, but that it detracts from their brilliancy and durability for exterior work. They stated that there is apparently no reason why Boswellia turpentine oil should not be utilized in the varnish trade.

Sample No. 2 contained a much larger percentage of the higher boiling constituents than the first sample, but nevertheless the varnish prepared with it dries rather quicker than that made with ordinary commercial turpentine oil. The inclusion of the higher-boiling fractions does not appear to have any adverse effect on the quality of the varnish, so that it would seem nnnecessary to remove these fractions in preparing the Boswellia oil for commercial use. The best rule on this point would probably be to make the product agree in range of boiling point with commercial American turpentine.

Favourable results were also obtained in the case of samples of oil submitted for technical trial in India. One report stated that it is suitable for paint-making, paint prepared with it drying in under twenty-four hours, whilst another firm stated that as regards volatility the oil is excellent and better in this respect than any of the samples of the oil of *Pinus longifolia* prepared in India which had been submitted to them.

There seems to be little doubt that this Boswellia turpentine oil could be successfully utilized for varnish-making in place of ordinary turpentine oil, but it is not possible to state its exact commercial value until the product has been tried on a considerable scale.

Two samples of Boswellia rosin were examined at the Imperial Institute in 1914. A summary of the results is given below together with those obtained in an investigation of three further samples received in 1916 and 1917.

Sample No. 1 was prepared by steam-distillation, and consisted of dark brown, very brittle resin, with a vitreous fracture. The resin resembled colophony in odour, and was practically tasteless.

Sample No. 2 was obtained by heating the resin in a still over a gentle fire. It consisted of dark, greenish-black, very brittle resin, with a vitreous facture. The resin had a slight "burnt" odour, but no taste.

Sample No. 3 was prepared in an extractor with light petroleum as a solvent. It consisted of golden-brown, brittle, transparent resin; its colour and appearance were approximately those of grade "G" colophony.

Sample No. 4 was described as " first instalment of Bosweillia rosin, slightly frothy, made in copper," and consisted of dark brown, very brittle rosin with a vitreous fracture; in thin layers it was transparent.

Sample No. 5 was described as 'third instalment, clear samples, fully heated though underboiled." It resembled sample No. 4 in every respect, except that in colour it was dark greenish-brown.

The results of the chemical examination of the five samples received at the Imperial Institute are shown in the following table, which includes for comparison the results obtained in India for two samples of Boswellia rosin prepared respectively with light petroleum and Boswellia turpentine as solvents :—

—	Sample examined at the Imperial Institute					Samples examined in India	
	1	2	3	4	5	Prepared with light petroleum	Prepared with Boswellia turpentine
Moisture per cent	0·7	0·9	0·7	0·8	1·1	...	...
Ash per cent	0·5	0·4	0·03	0·3	0·2	...	...
Melting point:							
Rosin softens at	73° C.	56° C.	68° C.	71° C.	65° C.	...	...
Rosin melts at	...	...	...	78°C.	73° C.	...	...
Acid value	51·5	25·0	55·1	52·4	50·8	43·71	42·51
Saponification value	92·0	66·0	90·2	87·8	75·6	89·66	88·40
Iodine value per cent	70·0	96·0	...	64·6	76·2	97·10	98·20
Specific gravity	1·012	1·050	...	1·077	1·059	...	1·058
	(at 20/20° C.)	(at 20/20° C.)	...	(at 18/18° C.)	(at 18/18° C.)	...	...

It will be seen that the constants of Sample No. 2 ffer from those of the other samples, and it would ›pear that this sample was abnormal.

The samples of rosin examined at the Imperial stitute were completely soluble in alcohol, ether, oloroform, benzene and turpentine oil, with the ception that Sample No. 2 was only partly soluble alcohol.

Varnish trials made at the Imperial Institute with ; rosin gave satisfactory results. In the case Samples No. 4 and 5 the varnishes used consisted 1 part of the rosin and 1 to 2 parts of turpentine. These varnishes, when applied to sized wood, ed rather slowly to a clear, bright, hard coat, ich adhered firmly and did not crack. Varnishes pared with 1 part of alcohol to 1 part of the ins gave the same result.

Boswellia rosin was found to be not completely soluble in sodium carbonate solution, even on prolonged boiling, and it could not therefore be used as a substitute for colophony in making rosin soap or rosin size.

Enquiries were made by the Imperial Institute as to the commercial value of the rosin and samples were submitted to firms for technical trial. A firm of importers valued the rosin at about £20 per ton in London (July, 1916). A firm of spirit varnish manufacturers described it as equal in all respects to American rosin, and quite suitable for making certain qualities of spirit varnishes. They regarded it as about equal to grade "G" of American rosin, the market price of which was £21 to £22 per ton in London (July, 1916). The normal value of this grade of rosin before the war was about £14 per ton. Another firm of varnish manufacturers carried out

experiments to ascertain whether the rosin could be used to replace American rosin in the manufacture of the cheaper varieties of varnish. The results were very satisfactory and indicated that the Boswellia rosin would be an excellent substitute for American rosin for this purpose. This firm stated that in their opinion the value of the Boswellia rosin would be the same as that of the American product, *i.e.*, 63*s*. per cwt. in the United Kingdom (September, 1918).

Equally satisfactory reports were furnished by firms in India to whom samples were submitted by the Forest Economist, and it seems quite clear that Boswellia rosin can be used by varnish makers in place of American rosin.

USES OF GUM OF BOSWELLIA SERRATTA.

Three samples of Boswellia gum were received at the Imperial Institute in May, 1916. They all appeared to be composed of the same material and to differ only in the size of the pieces composing the samples. Sample No. 1 consisted of small tears and fragments, No. 2 of small fragments, and N. 3 of very small fragments and dust, with some sand and dirt.

The three samples were analysed with the following results :—

	No. 1 Per cent.	No. 2 Per cent.	No. 3 Per cent.
Moisture	14·4	13·9	12·4
Ash	3·0	3·5	9·3 *a*
Matter soluble in 95 per cent alcohol ...	23·6	20·7	16·9
Matter soluble in 95 per cent ether	20·9	17·3	11·6
Matter soluble in 95 per cent cold water ...	42·9	48·5	39·2
Specific gravity of a 10 per cent solution at 15/15°C.	1·026	1·023	1·022
Viscosity of a 10 per cent solution at 22° C. *b*...	3·6	3·3	2·8

These results are compared in the following table with those obtained in India by the Chemical Adviser at the Forest Research Institute, Debra Dun, the Imperial Institute results being given under the heading A, and those of the Chemical Adviser under the heading B. In order to eliminate discrepancies due to variation in moisture, the results have been expressed in all cases on the dry materials.

—	Sample No. 1.		Sample No. 2.		Sample No. 3.	
	A	B	A	B	A	B
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
Ash	3·5	3·4	4·1	4·0	10·6	7·1
Resin (matter soluble in 95 per cent alcohol) ...	27·6	not given	24·0	10·2	19·3	21·2
Soluble gum (matter soluble in water) ...	50·1	not given	56·3	not given	44·8	not given
Insoluble gum and dirt (exclusive of ash) ...	18·8	...	15·6	...	25·3	...
Mater soluble in ether (dry and free from alcohol).	24·4	9·0	20·1	{ 9·4 8·3 }	13·2	{ 18·3 19·4

a The average of five determinations which varied from 7·3 to 10·8 per cent; owing to the presence of heavy sandy matter it was difficult to obtain a really average sample of the material.

b As compared with 1 for water and 6·5 for soft Kordofan gum, 7·1 for Sudan Talh gum, and 12·0 for hard Kordofan gum, determined under the same conditions.

It will be seen from these figures that the results obtained at the Imperial Institute for matter soluble in alcohol and in ether (which for either solvent may be regarded as rosin) do not agree with those found by the Chemical Adviser, and the latter points out in the paper referred to at the beginning of this article that the differences are due to the lack of uniformity in the samples.

With the view to ascertaining the suitability of the gum for sizing purposes the following attempts were made at the Imperial Institute to obtain "jellies" from the gum :—

(a) One part of the gum was allowed to stand over-night with 2 parts of water, and was then heated for one hour in a boiling-water bath and allowed to cool. Only a pasty mass was obtained.

(b) One part of the gum was allowed to stand over-night with 10 parts of water, after which it was warmed on a water bath and allowed to cool. The liquor was freed from solid matter by being squeezed through calico and the filtrate was concentrated on a boiling-water bath, but no jelly was obtained.

(c) One part of the gum was heated under pressure with 5 parts of water at 133°C. for 1½ hours, but yielded only a thin, non-homogeneous paste of a brown colour.

From these experiments it appeared that this gum is much inferior to ordinary gum for use as a sizing material, but it was nevertheless submitted to one of the most important British calico-printing firms for trial as a sizing and finishing material for textiles. Their technical experts reported as follows :—

(a) An attempt was made to obtain a solution in water at a strength of 4 : 10, but even with prolonged heating the result was nearly a rough pasty mass.

(b) The gum was then heated in a closed bottle for an hour under a steam pressure of 6 to 10 lb. This also failed to produce a smooth paste, though with undoubtedly better results as regard thickness. The material, however, was not sufficiently homogeneous to serve as a thickener or as a sizing agent.

(c) It was found that a strong solution of caustic soda dissolved the gum, but there was no "body" in the product and subsequent neutralization of the alkali with acid reprecipitated the gum.

(d) The gum was found to be but little affected by weak solutions of coustic soda, sodium carbonate or borax, and acetic acid was also without solvent action.

As a result of these trials the conclusion arrived at by the experts was that the "insolubility" of this gum (*i.e.*, the presence of resin and gum insoluble in water) would prevent its employment for the purpose of sizing and finishing textiles.

A further sample of the gum was forwarded to the Imperial Institute in December, 1917. It consisted of a finely ground, light buff powder with a pleasant aromatic odour.

The gum was submitted to chemical examination with the results shown in the following table, which also includes the results obtained at the Forest Research Institute in the case of a sample completely freed from resin and insoluble woody matter :—

	Sample examined at the Imperial Institute per cent	Sample examined in India per cent
Moisture ...	13·1	18·75
Ash	3·5	3·28
Water-soluble matter ...	75·7	74·20 *a* 74·35 *b*
Alcohol-soluble matter ...	2·7	not given
Viscosity of 10 per cent solution at 22°C. *c* ...	5·4	
Specific gravity of 10 per cent solution at 20/20°C. ...	1·031	

When dissolved in water the sample examined at the Imperial Institute formed a thick, cloudy, colloidal solution.

It will be seen from the above results that the later sample of Boswellia gum is superior in composition to the three previously examined, as it contains much less resin (alcohol-soluble matter) and is much more soluble in water. The viscosity of a 10 per cent solution of the gum is also greater than in the case of the earlier specimens. Even this sample, however, does not compare favourably with gum arabic. A 10 per cent solution in water was cloudy and had a lower viscosity than a gum arabic solution of the same strength ; it also darkened when heated and deposited solid matter on standing. The solution was fairly adhesive, but inferior to gum arabic in this respect. The 10 per cent solution did not form a jelly, and was much more liquid than a 5 per cent starch jelly.

a In 5 parts of water.

b Portion dissolved in 60 parts of water by repeated extraction.

c Compared with 1 for water and 6·5 to 7 for gum acacia under the same conditions.

The sample was too small to permit of any technical trials being made, but it seems unlikely that the material could be used to any extent as a substitute for gum arabic except possibly locally in India.

UNDER-EXTRACTED GUM.

Boswellia gum containing 30 to 40 per cent resin has been tried in India as a paper size. A cellulose expert who examined a sample of this material stated that the sizing effect he obtained was sufficiently good to warrant a commercial trial being made.

A sample of this gum was subsequently submitted to an Indian firm for trial under practical working conditions, with the following results:—Two experiments were undertaken with a sizing solution made up by dissolving 100 lb. gum with 3 per cent of 77 per cent caustic soda in 90 gallons of water. In the first experiment 500 lb. of "stuff" were beaten with 40½ gallons of the sizing solution, 25½ lb. of alum were then added; the quantities represented 9 per cent of gum and 5·1 per cent of alum. The sizing results in the finished paper were only considered fair. In the second experiment the quantities used represented 10 per cent of gum and 4·6 per cent of alum. The sizing results were in this case slightly better. In each experiment the wet pulp gave a more or less acid reaction. The firm stated that further trials would be necessary before any general conclusion could be drawn as to the value of the material for sizing paper, but they were of opinion that the large percentage of resin present might cause trouble in the machine, and produce early yellowing and rapid deterioration in the case of white paper.

PREPARATION OF BOSWELLIA PRODUCTS FOR THE MARKET.

The following recommendations are made by Messrs. Pearson and Puran Singh regarding the methods of preparing Boswellia products for the market.

Turpentine Oil—The authors agree with the view expressed in the earlier report made by the Imperial Institute that the oil should be marketed in the crude state, and that is inadvisable to rectify it.

Rosin.—Overheating should be avoided in the preparation of the rosin, for this in addition to darkening its colour, reduces its "strength." Care must also be taken to free it from fine particles of dirt by allowing sufficient time for settling in the tanks when the rosin is in a state of solution in the solvent. It seems impossible to remove the dirt at any other stage of working.

Gum.—The refinement of the gum on a large scale has been found to be difficult, and it is recommended that it be placed on the market in the form of "flour" as is done in the case of similar gums. In the process of grinding and sifting particles of bark are removed.

Under-extracted Gum—If further trial should demonstrate that this product can be used as a subsidiary sizing material, it would be quite easy to stop the extraction of the gum-resin at a fixed point in order to produce the mixed substance.

COST OF MANUFACTURE OF BOSWELLIA PRODUCTS.

In the form of a profit and loss account, Messrs. Pearson and Puran Singh have tabulated a rough estimate of the cost of preparing 77 gallons of turpentine oil, 55 maunds (=about 2 tons) of rosin, and 22 maunds (=about 16 cwts.) of gum, from 100 maunds (=about 3⅝ tons) of the crude *Boswellia serrata* gum-resin. The estimate of the total cost of collecting, distilling, interest on working capital, depreciation on plant, packing, insurance, etc., at 780 rupees (=£52). The values of the receipts are based on pre-war rates; the turpentine oil at 2½ rupees (=3*s*. 4*p*. per gallon, the rosin at 10 rupees per maund (=18*s*. 2*d*. per cwt.), making a total of 852½ rupees (=£56. 16*s*. 8*d*.). This would represent a profit of 72½ rupees per 100 maunds of gum-resin (=£4. 16*s*. 8*d*. per 8,228 lb., or nearly 1*s*. 4*d*. per cwt.).

The authors state that it will be necessary to confirm this estimated cost of manufacture in a single unit plant, before carrying out operations on a large scale; that there seemed no question of doubt as to finding a ready market for the turpentine and rosin, but that it was rather difficult to predict the market value of the gum, which, however, should sell readily at the above low price given in the estimate.

The above investigation has shown that *Boswellia* serrata gum-resin which has hitherto been employed in India to a small extent chiefly as a substitute for *B. Carteri*, and *B. Frereana* in the preparation of incense, is capable of furnishing products of considerable commercial importance and it seems probable that their preparation will constitute a profitable industry.

SERICULTURE.

Sericultural Experiments in India.

The following are extracts from the Report on the Progress of Agriculture in India for 1918-19, just published —

As an outcome of the recommendations made by Professor Maxwell-Lefroy in his report on the sericulture industry in India, a protozoologist has recently been added to the staff of the Imperial Department of Agriculture in India to investigate the diseases of silkworms. The establishment of a central seed store depote with a view to supply healthy seed to growers is under the consideration of the Government of India, and has been referred to Local Governments for their opinion. The establishment of such a central seed store must, however, await the results of the protozoologist's investigations.

At Pusa, work continues with the multivoltine mongrel races of mulberry silkworms which have been established by crossing univoltine and multivoltine races. It has been found that the yield of silk from the first generation of these mongrel crosses is always better than that in later generations which deteriorate gradually. Attempts are being made to prevent this deterioration by the infusion of new blood in the mongrel races. A rabe has now been establised which, on crossing with univoltine races, changes the resultant mongrel races into multivoltine in five or six generations, so that any univoltine races can be made multivoltine in a comparatively short time. Mulberry and *eri* silkworm eggs were supplied to several provinces, Indian States and other applicants from all parts of India as well as to several foreign countries. One Pusa reeling machine was supplied to the Agricultural Department, New South Wales, and another to the Indore State. Many enquiries regarding rearing, reeling, dyeing, bleaching, spinning and twisting have been dealt with,. and four students have received short courses of training in sericulture during the year.

In Bengal work on the improvement of the mulberry silkworm races by hybridization is in progress. The object is to evolve superior multivoltine hybrid races which will retain the good characteristics of the indigenous races and, at the same time, yield more silk. By selection from a very large number of hybrids, the department has now obtained four principal types of good promise. These races, which had previously been reared on an experimental scale only, have, since March, 1918, been reared on a field scale with a view to avoid any chance of experimental errors. It is satisfactory to note that so far they have not shown any signs of degeneration.

In the Punjab, sericulture has received a great set-back on account of the failure of the year's crop due to late arrival of the seed from France. Necessary precautions have been taken to avoid the recurrence of such a mishap, and as the province has now got a whole time Entomologist it is hoped that the subject will receive more attention than it has hitherto been possible to give to it.

In Burma, the sericultural experiments at Amarapura were continued but considerable difficulty was experienced in supplying mulberry leaves to growers during the hot weather. Mr. H. A. Thornton, C.I.E., I.C.S., has continued his efforts to start the industry in the Northern Shan States on sound lines, and has obtained from Pusa the services of two skilled men to give local training in the methods of rearing silkworms. Two demonstrators have also been posted to Paukkaung in the Prome district to train the silk-breeders there.

"TUKRA" OF MULBERRY.

It has been definitely ascertained that the "Tukra" or "Kokra" disease of mulberry is caused by a mealy-bug (*Phenacoccus hirsutus*), which is found on the plants together with *Pseudococcus virgatus*. The nymphs as well the adult females congregate on the shoots of the stems and cause their malformation in infested mulberry plantations. The growth of the affected plant is retarded while the lower lateral leaves become wilted and drop off. The affected apical leaves, if served to mulberry silkworms, cause "flacherie." The presence of this mealy-bug is indicated by ants (*Monomorium indicum*) which attend the scale insects for the sake of their honey-dew. Ten generations of *Phenacoccus hirsutus* were reared at Pusa during the year and its parasites and predators were also studied, together with the means of its dispersal and the best method of treating affected plots.

PEBRINE.

Owing to the use of multivoltine races of silkworms in India and the generally insanitary conditions under which rearing is carried out, it is essential for the rearer to begin his season with disease-free seed. In default of this the rapid cumulative effect of any small percentage of disease initially present will, in the course of rearing the numerous broods characteristic of these races, inevitably result in the failure of a fatally large proportion of the worms. For this reason it is necessary to adopt in India a much higher standard of purity in the seed issued by *grainages* than is customary in England. The method of examination

of moths devised by Mr. Hutchinson to meet this necessity, referred to in the last year's report, has been adopted by various *grainages* in India and favourable reports on the success of its use are being received. Mr. Hutchinson was engaged in further study of the problem of elimination of this disease which included trial of the effect of hill-rearing upon the natural resistance of the larva to infection. Experiments were carried out at Shillong during August and September and it was found that even in the first generation a considerable increase in resistance to infection was obtained in the hill-reared larvæ. Eggs from the latter were transferred to Pusa both from infected and from disease-free moths, and further resistance to infection in the plains was noted in the latter, whilst in the former a smaller percentage of infected larvæ resulted from the batching out of seed from the diseased moths. The infected larvæ survived through a greater number of moults and a larger percentage of them attained maturity than is usual in such cases. It was also noted that the hill-reared worms produced better cocoons. A Memoir by Mr. Hutchinson on the mechanism of infection and the elimination of pebrine in India is now in the press.

MEDICINAL PLANTS IN INDIA: PROSPECTS OF CULTIVATION.

Appointment of a Committee.

The Secretary to the Drugs Manufacture Committee has issued the following Press *communique*:—

At its 34th meeting held at Simla on the 20th May, 1918, the Board of Scientific Advice accepted a proposal for the formation of a Drugs Manufacture Committee to investigate the possibilities of the cultivation of medicinal plants in India and the manufacture of drugs from them on a commercial scale. The Government of India have acted on this recommendation and have appointed a Committee whose primary functions will be to investigate (1) the possibilities of the cultivation of medicinal plants in India, and (2) the manufacture of drugs from them on a commercial scale.

With regard to (1), the Committee will consider the various lines on which the investigation can best be undertaken, while in connection with (2), it will consider the present position as regards the manufacture of drugs in India from indigenous products and the Indian requirements of such drugs as have up till now been imported from abroad. As soon as experience has proved that any drugs can be manufactured at Government Medical Store Depots at a sufficiently low cost, private enterprise will be invited to undertake its manufacture.

The first meeting of the Committee was held at Simla on the 20th May, 1919, when it was resolved *inter alia*: (*a*) that the main investigation of the Committee should be conducted in the laboratories of the Government Medical Stores Department and that the question of the manufacture of drugs from other than vegetable sources should come within the scope of the Committee's work; (*b*) that measures should be taken for ascertaining the geographical distribution of various medicinal plants throughout India and the extent to which they are now cultivated; (*c*) that the operation of the Committee should include the investigation of indigenous drugs which are not at present included in the British pharmacopœia; (*d*) that the Committee should give every assistance to any organization which is brought into being for the purpose of investigating and manufacturing preparations designed for use against disease-carrying and other insects; and (*e*) that local Governments and administrations should be informed of the establishment of the Drugs Manufacture Committee and requested to furnish the Committee with any information likely to be of value. The personnel of the Drugs Manufacture Committee as at present constituted is as follows:—

The Director-General, Indian Medical Service, Member and Chairman *ex-officio*; the Assistant Director-General, Indian Medical Service (Stores), Member *ex-officio*; and Secretary.

Members: The Agricultural Adviser to the Government of India; the Director, Botanical Survey of India; the Director, Geological Survey of India; Mr. F. M. Howlett, Imperial Pathological Entomologist; the Assistant Inspector-General of Forests; the Advisory Chemist, Madras.

All communications should be addressed to the Secretary, Drugs Manufacture Committee (Office of Director-General, Indian Medical Service).

Considerable progress has already been made as is shown by the fact that, among others, the following articles, which, prior to the war, were imported, are now being manufactured in the Government Medical Store Depots:—Absolute alcohol; Aloes preparations; Amylum, B. P. (Starch); Argenti Nitras; Argenti Nitras Induratus; Belladonna preparations; Borated Talc powder; Calcium Carbonate precipitated, B. P.: Calcium Chloride; Calcium Phosphate: Calcium Sulphide solution; Citric Acid

and Citrates; Collodium; Collodium Flexile; Creta Preparata, B. P.; Digitalis preparations; Extract Belladonna Siccum; Extract Cascara Sagrada Liquidum; Extract Cascara Sagrada Siccum; Extract Colocynth Co. (dry extract); Extract Glycyrrhiza Liquidum; Extract Hyoscyamus; Extract Nux Vomica Siccum; Extract of Vitamina; Extract Opii Siccum; Ferri Sulphas; French Chalk; Glucose; Iodine powder; Keratine solution; Lysol; Magnessi Carbonas Levis, B. P.; Mannite, Nux Vomica preparations; Oleic Acid; Oleum Anethi; Oleum Anisi; Oleum Carrophylli; Oleum Cedri; Oleum Chaulmogrœ; Oleum Crotonie; Oleum Myristica; Oleum Santali; Oleum Theobromatis; Oxymel Scillæ; Potassium Carbonate, B. P.; Pyroxylinum; Rectified Alcohol; Sapo Mollis; Sodium Carbomas, B. P.; Sodium Chloride chemecally pure; Sodii Nitris; Sodii phosphas; Sodii Sulphas; Syrupus Ferri Phosphatis Co.; Talc; Talc purtificatum Tannic Acid; Thymol, B, P.; Tinctura Colochici U., M. jC shrdlu aoinu Tinctura Colchici Cormus; various mercurial B. P. preparations.

MYSORE ECONOMIC CONFERENCE.

SHOWS AND EXHIBITIONS.

Cattle Show at Chunchankatte.

In connection with the *Jatra* at Chunchankatte held in January last, a Cattle Show was held on the 17th idem. There were about 28,800 heads of cattle at the Show, and the tolls collected on shops and cattle amounted to Rs. 3,600. The Sub-Division officer, the District Economic Superintendent, the District Sanitary officor, Mr. Rama Row of the Palace Veterinary Department, besides the representatives of other departments were present during the busy portion of the *Jatra* and ran the Show. A committee of six gentlemen was appointed to select cattle to be let into the Show stall and those deserving of prizes. Prizes in the shape of gold and silver medals of the aggregate value of Rs. 200 were distributed by the Sub-Division officer to the owners of deserving cattle. Certificates were also issued to the winner of each medal and photoes of prize-winning cattle taken. The total income from tolls, manure and golaka was Rs. 4,163-5-3 and the expenditure amounted to Rs. 960-13-10. The Agricultural Inspector of Mysore District exhibited agricultural implements and the Sericultural Inspector held a demonstration of sericultural exhibits.

BOOKS IN BRIEF.

On the payment of National Debt.—*By W. L. Jordan, Author of Standard of Value, etc. Published by Simpkin, Marshall, Hamilton, Kent & Co. Third Edition.*

This is a reprint of four letters addressed to a statesman by the author. Mr. Jordan urges, in these letters, a capital levy to clear off *all* the existing debt. He outlines a scheme for the purpose. He thinks his scheme is a practical one. He is of opinion that it is better for the industrial development of the country if it is allowed to work immediately without being hampered by income-tax or without the burden of an annual charge of £450 *million* a year for 55 years. Mr. Jordan quotes Ricardo in support of his view and the scheme he propounds is no doubt an attractive one. The examples of those European countries which have adopted it do not encourage us in the hope that its effects are all for the good of the country or nation adopting it. Still Mr. Jordan's views are shared by many in England and a really democratic Government may not shrink from them. We must say Mr. Jordan puts this case pointedly and briefly in his letters and any dispassionate person reading it is likely to be favourably impressed by the soundness of his arguments.

Loans Versus Taxes in War Finance.—*By Edwin R. A. Seligman, Professor Columbia University.*

This booklet forms publication No. 1165 reprinted from *Financing the War*, Vol. lxxv of the Annals of the American Academy of Political and Social Science, Philadelphia. In it Professor Seligman considers at length the vexed question of loans *versus* taxes in war finance. His conclusion, which we give below, is the only sound one that any practical financier can arrive at. It is quite in keeping with the views of financiers and economists in England. Professor Foxwell, for instance, has propounded nearly the same views in several of his articles on the subject of War finance. Professor Seligman thus summarises his conclusion:—(1) Government loans are indispensable to a sound war finance. If properly used they tend to lighten the burden of war. (2) To attempt to finance a war exclusively through loans is short-sighted. (3) To attempt to finance a war exclusively through taxes is suicidal. (4) War taxes should be large and immediate, but should never be stretched beyond the point where they begin to lessen the social output, to hamper the transfer of pre-war to war production, or to press unduly on desirable consumption. (5) War

taxes must be high enough to assure a solid foundation for the loans and to ensure a rapid payment of the debt within a relatively short time. (6) At the outbreak of a war, and during the early period, very much greater sums ought to be raised by loans than by taxes. (7) As the war proceeds a continuously larger amount can and should be raised by taxation, although at no time will the Government be free from the necessity of relying to a considerable extent upon the use of public credit.

Currency Reform in India.—*By V. G. Kale, Professor of Economics, Fergusson College, Poona. Published by Aryabhushan Press, Poona City.*

A reprint of articles contributed to various journals, with additional chapters of importance, this book deals with a matter of great interest to this country. In it Professor Kale urges earnestly for a currency system solely intended in the interests of India. He pleads for an effective gold standard with free importation of gold into the country. He also pleads for the establishment of a gold mint in India, the issuing of gold notes to expand the calculation of notes of small denominations, with improved facilities for free and ready encashment of same, for the issue of subsidiary coins of a metal other than silver to relieve the pressure on rupee circulation and for the establishment of a State Bank in India for undertaking all the banking work of this country. Professor Kale's book deserves a wide circulation, for it is both informing and sound.

Mass and Agriculture.—*By Nagendranath Gangule, B. Sc. (III)—Published by the Commonweal Office, Adyar, Madras.*

This little book deals with some of the lessons to be derived from one aspect of war's effects--on Agriculture. Its object is to enable people to form a healthy public opinion in favor of a constructive agricultural policy in this country. Some of the topics dealt with are:—War and agriculture, increased food production from soil, food conservation and food distribution. Harvest prices of jute forms Appendix A. Agricultural Reconstruction in Great Britain and Ireland taken from this *Journal* forms Appendix B. The book is a suggestive one and ought to achieve its object.

Inflation.—*By J. S. Nicholson, M. A., Sc. D., L. L. D., Professor of Political Economy in the University of Edinburgh. Published by P. S. King & Son Ltd., Westminister, London.*

Recently we reviewed in these columns Professor Cannan's book on "*Money*" and in that connection drew attention to his views on inflation. Here is another book by Professor Nicholson on the same subject. It is a highly stimulating one. Professor Nicholson says that "our greatest present need is to get back to a sound monetary system and to get rid of the mirage of inflation". Again, he says: "The principle cause of the disorder of the body politic is the abuse of paper money. "The great expansion of currency is the root of all our economic ills." He tells us plainly that he has called his book "inflation *sans phrase*" because he explains, "the word suggests besides the usual monetary meanings, all sorts of flabby moralities and bombastic utterances. We want to get back not only to hard money but to hard thinking, we live in the world of money and when anything goes wrong with the money our whole world is shaken." The book is no mere destructive piece of work. As may be expected from one so high in Economic thought as Professor Nicholson is, it is full of meat. No book of the size has, so far as we know, dealt with the whole subject of war time finance in a more illuminating manner.

Mysore Forest Trees.—*By Rao Saheb M. Rama Rao, Special Forest Officer in Mysore. Printed and Published by Bangalore Press, Bangalore.*

Rao Saheb Mr. Rama Rao, Special Forest Officer, Mysore, has favoured us with a list of Mysore Forest Trees which is of much interest, both as a botanical record and as a guide to persons concerned with the industrial expansion of the State in connection with its forest resources. The one book now available on the subject is Camerons "Forest Trees of Mysore and Coorg" which was published a quarter of a century ago; and regarding which Mr. Cameron himself when publishing it wrote: "But although our knowledge of arboriculture is improved, a reference to the text will reveal that there is still much to be learnt concerning the identity, nomenclature, utility and treatment of local trees; and, until these sources of information have been fully explored and exhausted, we cannot hope to possess a complete Hand-book of the Forest Flora of Mysore and Coorg." Mr. Rama Rao, in the publication under reference, has successfully attempted a compilation which will be within the easy reach of persons anxious to obtain more or less reliable information regarding the economic value and commercial possibilities of little known trees within the State, their distribution and their future value towards meeting the new demands for special kinds of timber in India from foreign countries, where the economic progress made is on a vastly higher plane than has been achieved in this country. Mr. Rama Rao's list of trees does not pretend to be either exhaustive or meticulously accurate in all respects. His information has been obtained from existing publications most of which is enshrined in costly and bulky tomes not ordinarily accessible to merchants and consumers—and from personal investigation extending over a period of two and half years. The last is calculated to be

of some assistance in ascertaining the economic uses of the trees mentioned in view to the collection of further information regarding their local uses, distribution, extent of occurrence, their properties, durability, identification, sources of minor forest produce in tanin materials, resins, oils, etc., and their suitability for particular manufactures. Owing to the miserable industrial condition of India, as a whole, the exploitation of forest resources has been limited, to only a dozen kinds or so of Forest trees, with the result that a very serious depletion of such trees has occurred; and if Mr. Rama Rao's list influences the consuming public to avail themselves of other less known timber in any degree, not only will the drain on the timbers hitherto over-exploited for most purposes, be lessened, but will help to placing equally useful and suitable timbers for house construction and manufacture of all kinds on the market to the financial benefit of the State. It is the same case in Travancore where the forests have been grievously overfelled in respect of teak *Marudu*, *Vengai* and half a dozen other species. Mr. Rama Rao's list comprises nearly 500 trees including the coniferæ which are not indigenous—cycads, palms and bamboos. One of the great wants of India is wood suitable for the making of pencils, and from the column of uses to which various timbers can be put, we note that Mr. Rama Rao mentions several trees which in his opinion, might be found of use. It is possible that practical experiment might demonstrate that Mysore at least, and other parts of India where similar trees exist will be able to furnish pencil making trees equal in value to the Juniper timber of British East Africa upon which the Inspector-General of Forests in British India declared, at the last sessions of the Board of Forestry, held in March and April of last year, we are wholly dependent for the manufacture of first grade pencils. A perusal of the list, it is interesting to note, that the *Juniperus procera* or the East African pencil ceder, apparently the same tree mentioned by Mr. C. S. Hart, C.I.E.—has been imported into Mysore and is "growing well" in the Lalbagh and in the grounds of certain forest lodges in the State. If the trees continue to flourish there is no reason why they should not be extensively planted up for future use.

In Mr. Bourdillon's list of over 550 havacane trees—some few of which are shrubs—there are many which grow in the uplands and deciduous forests of Mysore indicating that Mysore climatic conditions favour the growth of trees which are mostly formed in the hilly tracts of the West Coast where the rainfall is exceptionally heavy. If we make no mistake Mr. Rama Rao, when Conservator of Forests in Travancore, added considerably to the information to Mr. Bourdillon's list, and it seems to us that a conference of Forest Conservators of the Native States in South India not excepting the Hyderabad Dominions would serve a useful purpose in comparing the forest resources of each State in view to combined action in developing them in commercial and industrial directions. Mr. Rama Rao deserves immence credit for his compilation inasmuch as it forms the basis on which "a cheap and exhaustive Handbook containing full information on the structral characters and properties of Mysore woods and minor products, their present local uses, their future industrial, economic and commercial possibilities, their geographical distribution and extent of occurrance, their local nomonclature in different parts of the country etc., will soon be made available for the use of forest officers and the intelligent sections of timber traders and consumers. May we be pardoned for making one suggestion. It is to supply besides the Mysore Vernacular names, the Malayalam, Tamil, Telugu and wherever possible the Hindustani nomenclature for easy reference by men who do not know Latin terms known only to the uninitiated. Another suggestion is that in investigating the properties of the trees the calorific value of the various trees commonly used for domestic, cooking, furnaces, etc., should if possible be determined. The fuel problem of India is of very great importance and economy in the use of fuel is a desideratum which deserves attention. From a financial point of view the price of fuel could be regulated by its colorific value.

ACKNOWLEDGMENTS.

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